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Original Research Article

Effect of Phosphorus and Growth Regulator on Yield and Uptake of Nutrients by Cowpea (*Vigna unguiculata* L.)

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Keywords

Fodder yield, Nutrients Composition, Nutrients uptake

A B S T R A C T

A field experiment was conducted during kharif season of 2017 at the Agriculture Research Farm of R.B.S. College, Bichpuri, Agra to study the effect of phosphorus and growth regulator on the performance of cowpea. The soil application of 60 kg ha-[1] phosphorus as super phosphate single, growth regulator as seed soaking with 200 ppm NAA is recommended for obtaining higher production of cowpea fodder. Application of phosphorus and (NAA) growth regulator with seed soaking treatments improved the composition and uptake of nitrogen, phosphorus, potassium and zinc by cowpea.

Introduction

Cowpea (*Vigna unguiculata* L.) is one of the most important fodders in kharif season in Agra region. It is only of preferable nature fodder for cultivation in adverse climate/ soil conditions of this region. Cowpea contains about 24 percent protein and is a rich source of calcium and iron. It can also be used as green manure. It acts as cover crop on the soil and protects it from erosion. The benefit has been attributed to the fixation of atmospheric nitrogen through the agencies of bacteria contained in the nodules on the roof of plants. Phosphorus is essential element required for plant growth and root development. It is found in every living cell of the plant and animals. It is known to be associated with several vital functions in the plant body such as utilization of sugar and photosynthesis, nucleus formation, cell division, fat and albumin formation, cell organization, and transfer of the heredity. The availability of phosphorus from soil to plants depends on the equilibrium adjustment around the root zone. The equilibrium is influenced mainly by salt concentration, pH, calcium carbonate and nature of exchangeable complex and organic matter. Paliwal and Gandhi (1976) concluded that in highly saline sodic media about 10-15% more needed. The hormone supply from roots to the leaves, consequently resulting into growth inhibition (Kessler, 1961). A numbers of hormones such as IAA (Kudrev and Tyankava, 1966) and NAA (Darra *et al.*, 1973) have been found to be useful in

minimizing the effects of poor quality water on crop through different ways. The pre sowing seed socking in the said hormones have been found to increase the yield and nutrient uptakes under saline environment by Balki and Padole (1982). The grain yield improved by 42% and 23% with 10 ppm of 2,4-D and NAA over control. The results on growth and maturity indicate that 2, 4-D and NAA proved relatively more than IAA. The present study was undertaken to effect of phosphorus and growth regulator on yield and uptake of nutrients by cowpea.

Materials and Methods

The field experiment was conducted at the agriculture research farm of R.B.S. College, Bichpuri, Agra during Kharif season of 2017. The soil had pH 8.3, EC 0.20 dSm^{-1} at 25 ^{0} C, Organic carbon 0.38%, Calcium carbonate 1.28%, Available N 228.5 kg ha^{-1}, P 18.6 kg ha^{-1}, K 150.8 kg ha^{-1}, Zn 3.8 ppm. The treatments consisted of 4 levels of phosphorus (control, 20, 40, 60 kg ha^{-1}) and five levels of growth regulator as (NAA)(control, 100, 150, 200 and 250 ppm) were laid out in randomized block design (R.B.D) with three replications. Variety of cowpea was Local. Green foliage and straw yield was recorded at harvest. Whole amount of potassium as recommended dose was applied as muriate of potash at the time of sowing. The recommended dose of nitrogen and potassium were supplied through urea and phosphorus was given through single super phosphate. The cowpea (Local), seed was sown at the rate of 100 kg ha^{-1}, sowing was done in the furrows behind the plough drawn by bullocks. The furrows were opened 30 cm. Equal amount of water was applied to every pot at the time of irrigation. The plants were harvested fodder after 60 days. At the time of harvest the green foliage yield was recorded after drying in oven. The dry matter yield was also recorded. The plant samples collected from individual pots were washed with distilled water, dried and grind in Wiley Mill. The finely grind material was then subjected to chemical analysis. N was estimated by Colorimetric methods of analysis Vol. IInd, page 813-16 by Snell and F.D. Snell, C.T.(1955), P by Johnson and Urich(1959), K by flam photometer. The uptake values of N, P, K and Zinc by cowpea crop were calculated by using the content(%) of nutrient and its corresponding yield values.

Results and Discussion

The data (Table-1) revel that the green foliage yield of cowpea increased significantly with increasing levels of phosphorus. The phosphorus levels P1, P2 and P3 resulted 7.69,13.84,and 22.71 percent enhancement in fresh weight over control, respectively. The maximum fresh weight was recorded with highest level of phosphorus. This increase might be due to well-developed root system, which might have helped in increased nitrogen fixation and its availability to the plants along with other nutrients. Similar to these findings Luikham *et al.*, (2015).

The table-1 further indicates that all the seed soaking treatments[with growth regulator(NAA)] significantly increased the green foliage yield of cowpea expect with T_1 treatment in comparison to control. In general, superiority of seed soaking treatments could be arranged as $T_4>T_3>T_2>T_1>T_0$ in case of green foliage yield of cowpea. Similar to these findings, the useful effect of seed soaking treatments with NAA on green foliage yield and dry weight is due to increment of cellulose, an accelerated rate of respiration and rapid synthesis of proteins monosaccharides and polysaccharides (Gordon 1952). These results are in agreement with the opinion of Seshadrinath (1990) who observed that all

growth regulators applied at any stage proved useful for growth and yield of chickpea. Similar to these findings Thakur *et al.,* (2008) and Kumawat *et al.,* (2010). The dry weight of cowpea increased significantly with increasing levels of phosphorus in comparison to control (P_0), expect P_1 and P_2 levels of phosphorus. The phosphorus levels P_1,P_2,P_3 resulted 0.17,0.20 and 0.23 percent enhancement in dry weight over control respectively. The maximum dry weight was recorded with highest level of phosphorus(60 kg ha-1). Similar resulted were observed by Lal *et al.,* (2014) and Luikham *et al.,* (2015). Table further indicates that all the seed soaking treatments [with growth regulator(NAA)] significantly increased the dry weight of cowpea expect with T_1 treatment in comparison to control. In general superiority of seed soaking treatments would be arranged as $T_4>T_3>T_2>T_1>T_0$ in case of dry weight of cowpea. Similar results were observed by Singh and Pandey (2009) and Kumawat *et al.,* (2010).

It could be inferred from table-2 that the levels of phosphorus affected significantly the nitrogen content of cowpea. Enhanced levels of phosphorus increased significantly the nitrogen content of cowpea as compared to control. Similarly each higher level of phosphorus increased significantly the nitrogen content of cowpea over each preceding lower level of phosphorus as also noted earlier by Patel *et al.,* (2005), Singh *et al.,* (2005) and Singh *et al.,* (2010). The table-2 further indicates that a significant increase in nitrogen content was recorded with each NAA levels over control (T_0). The NAA levels T_3 and T_4 were found at per in case of nitrogen content of cowpea. The maximum and significant nitrogen content was obtained with T_3 and T_4 (200 and 250 ppm NAA) seed soaking treatment over control. The superiority of the seed soaking treatments may be arranged as $T_4>T_3>T_2>T_1>T_0$ in case of nitrogen content. Similar to these findings Chippa *et al.,* (1993). The levels of phosphorus affected significantly the phosphorus content of cowpea. Enhanced levels of phosphorus increased significantly the phosphorus content of cowpea as compared to control. Similarly each higher levels of phosphorus increased significantly the phosphorus content of cowpea over each preceding lower levels of phosphorus are also noted earlier by Islam *et al.,* (2005). The table-2 further indicates that s significant increase in phosphorus content was recorded with (NAA) all seed soaking treatments over control (T_0). The seed soaking treatment T_3 and T_4 were found at par in case of phosphorus content of cowpea. The maximum and significantly phosphorus content was obtained with T_4 (250 ppm NAA) seed soaking treatment. The superiority of the NAA levels may be arranged as $T_4>T_3>T_2>T_1>T_0$ in case of phosphorus contents. Similar to these findings Chippa *et al.,* (1993) and Gupta *et al.,* (2006).

The potassium and zinc content of cowpea increased significantly with increasing levels of phosphorus over control except P_1, where the difference between P_0 and P_1 was not significant. The P_3 (60 kg ha^{-1}) levels of phosphorus proved superior over other treatments. The treatments T_3 and T_4 were differ significantly in case of potassium, zinc content of cowpea. Table-2 reflects that the potassium, zinc content of cowpea increased significantly with each NAA levels of seed soaking treatments over control. On the other hand seed soaking treatment T_3 and T_4 (200 & 25 ppm NAA) proved better over other seed soaking treatments. These results are in favour of Chippa *et al.,* (1993).

Table.1 Effect of phosphorus and NAA levels on green foliage and dry matter yield (g plot-^{1}) of cowpea

Treatment	Cowpea yield (g plot-^{1})	
	Green foliage	**Dry matter**
Phosphorus levels		
P_0	90.69	9.68
P_1	101.21	10.17
P_2	111.54	10.32
P_3	118.17	11.19
S.Em+-	1.32	0.2
C.D. at 5%	3.78	0.57
NAA Levels		
T_0	91.12	8.86
T_1	94.32	9.14
T_2	103.01	10.11
T_3	110.23	10.48
T_4	111.37	10.79
S.Em+-	1.21	0.140
C.D. at 5%	3.45	0.40

Table.2 Effect of phosphorus and NAA levels on nitrogen, phosphorus, potassium (%) and zinc(ppm) content of cowpea

Treatment	Nutrients content			
	Nitrogen (%)	**Phosphorus (%)**	**Potassium (%)**	**Zinc (ppm)**
Phosphorus levels				
P_0	1.09	0.17	1.30	1.18
P_1	1.12	0.17	1.33	1.20
P_2	1.15	0.20	1.36	1.23
P_3	1.19	0.23	1.38	1.26
S.Em+-	0.0022	0.0014	0.01684	0.01122
C.D. at 5%	0.0064	0.004	0.048	0.032
NAA Levels				
T_0	1.11	0.13	1.29	1.17
T_1	1.15	0.17	1.32	1.19
T_2	1.18	0.20	1.35	1.21
T_3	1.21	0.25	1.37	1.24
T_4	1.20	0.24	1.36	1.25
S.Em+-	0.002	0.0022	0.0136	0.01017
C.D. at 5%	0.007	0.0064	0.039	0.029

Table.3 Effect of phosphorus and NAA levels on nitrogen, phosphorus, potassium (mg plot-^{1}) and zinc (µg plot-^{1}) uptake of cowpea

Treatment	Nutrients Uptake			
	Nitrogen	**Phosphorus**	**Potassium**	**Zinc**
Phosphorus levels				
P_0	106.69	15.51	109.60	11.53
P_1	115.15	18.35	136.53	12.31
P_2	120.07	21.73	141.79	12.81
P_3	132.15	26.86	155.67	14.20
S.Em+-	1.431	0.575	1.82	0.241
C.D. at 5%	4.08	1.64	5.19	0.688
NAA Levels				
T_0	99.33	13.29	115.30	10.45
T_1	106.13	16.46	121.68	10.97
T_2	120.40	21.23	137.61	12.32
T_3	127.06	25.19	144.88	13.11
T_4	131.47	28.07	149.02	13.57
S.Em+-	1.385	0.0515	1.74	0.287
C.D. at 5%	3.95	1.47	4.98	0.820

The nitrogen, phosphorus, potassium and zinc uptake increased significantly with increasing phosphorus levels as compared to lower level of phosphorus. It appears due to increase in nitrogen, phosphorus, potassium and zinc content and dry weight with phosphorus fertilization. Our findings are in agreement with those of Kumar *et al.,* (2009), Kumawat and Kumawat *et al.,* (2009) and Singh *et al.,* (2010).

Table-3 indicates that the nitrogen and phosphorus uptake increased significantly with the application of each levels of NAA. The T_3 and T_4 levels of NAA gave better performance in case of nitrogen and phosphorus uptake by cowpea. Although T_3 and T_4 levels do not differ significantly in case of nitrogen and phosphorus uptake by cowpea. The increase uptake of nitrogen and phosphorus may be due to more absorption of nitrogen and phosphorus in the presence of applied of growth regulators as earlier reported by Chippa *et al.,* (1993), Gupta *et al.,* (2006). The potassium and zinc uptake increased significantly with applying the NAA levels as seed soaking treatments. The increase uptake of potassium and zinc may be due to more absorption of potassium and zinc in the presence of applied of seed soaking treatments as earlier reported by Darrar and Saxena (1974), Gupta *et al.,* (2006), Singh *et al.,* (2009).

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