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Effect of different levels of nitrogen and phosphorus on cowpea [V*igna unguiculata* (L.) Walp] under rainfed conditions of Rajasthan

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Abstract

An field experiment was conducted during *kharif* 2014 and 2015, at Central Sheep and Wool Research Institute, Avikanagar (Rajasthan) to study the effect of nitrogen and phosphorus levels on growth attributes, herbage yield and quality of fodder cowpea [*Vigna unguiculata* (L.*)* Walp.]. All growth attributes were significantly (plant height, branches/plant) higher with 30 kg N/ha applied to cowpea. Maximum green fodder, dry matter yield and crude protein content were recorded (178.11 and 36.12 q/ha and 18.07%) with the use of 30 kg N/ha. Besides, Crude protein content was increased greater extent upto 30 kg N/ ha, but the differences between 20 and 30 kg N levels was found remained at par with each other for protein content in haulm of cowpea. The application of phosphorus upto 60 kg P_2O_5/ha resulted maximum raised in green fodder and dry matter yield (179.06 and 35.83 q/ha) as compared to other levels. Crude protein content in dry matter was responded well upto 60 kg P_2O_5 /ha and it was increased by (12.50%) higher over control. The higher net return in terms of gross income (Rs. 28896/ha), net return (Rs. 17044/ha) and benefit: cost ratios (1.69) were realized under 30 kgN/ha. Similarly, 60 kg P_2O_5 /ha in cowpea gave the additional gross return (Rs. 8100/ha) and net return (Rs. 1769/ha) as compare to without use of phosphorus. Significant interaction of nitrogen and phosphorus levels was noted on green fodder yield.

Key words: Cowpea, Yields, Nitrogen, Phosphorus, Protein, Economics

Introduction

Cowpea (*Vigna unguiculata*) is an important fodder crop during rainy season because it has short duration, high yielding and quick growing capacity along with high protein content and palatability particularly to small ruminants. The production potential of cowpea is still low due to growing on hungry as well as thirsty soils of Rajasthan. Cowpea grains are consumed as food and the haulms are fed to live stock as a nutritious fodder (Ahmed et al. 2010). Besides, it fixed atmospheric nitrogen resulting increase in soil fertility. Coupled with these attributes, its quick growth and rapid ground cover checks soils erosion, and root decay in- situ produces nitrogen-rich residues that improve soil fertility and structure. Altogether these characteristics have made cowpea a valuable component of subsistence agriculture particularly in the dry parts of the country (Singh et al. 2003). It has the high vegetative growth and covers the ground surface resulting check the soil erosion in highly degradable areas. But the productivity of this crop is poor due to inadequate use of nitrogen fertilizer cause hindrance of physiological processes such as photosynthesis, respiration and metabolism activities. Another important indispensable nutrient is considered phosphorus because it has several beneficial effects upon the plant growth in the form of cell elongation, cell division and formation of roots nodules. The importance of all these things in order to a field experiment was conducted on response of fodder cowpea to graded levels of nitrogen and phosphorus on productivity and economic return in semi arid region of Rajasthan

Materials and methods

The field experiments were conducted at Central Sheep and Wool Research Institute, Avikanagar (Rajasthan) during *kharif* season of 2014 and 2015. The soil was sandy loam with pH 7.9, low in organic carbon (0.22%) and available N (126.3 kg/ha) and medium in available P (17.23 kg/ha) and K (149.26 kg/ha). The sixteen treatment combinations consisting of four levels of nitrogen (0, 10, 20 and 30 kg/ha) and four levels of phosphorus (0, 20, 40 and 60 kg/ha) were evaluated in randomized block design with four replications. Cowpea variety 'EC 4216' spaced 30 cm apart was used as a test crop. The crop was sown in kharif season first week of July. The nitrogen was applied through urea and phosphorus through single super phosphate (SSP). The seed rate of cowpea was 30 kg/ha drilled in lines at a depth of 5 cm by '*Kera'* method in open furrows in which fertilizer was drilled. The crop was harvested at the initiation of pods. The green fodder yield from each net plot was recorded separately and converted in to quintal per hectare .The dry matter production per plot was worked out with the help of dry matter content of oven dried samples of individual plot and was converted into quintal per hectare. Nitrogen content (%) in fodder was multiplied by a constant factor 6.25 to estimate the crude protein content (AOAC 1960). The economics of each treatment was calculated on the basis of prevailing market prices of input and output.

Results and discussion

Response to nitrogen: Application of nitrogen had brought significant effect on plant height of cowpea at harvest. However, differences among the treatments themselves did not found significant except control and 10 kg N/ha (Table1). The number of leaves/plant were increased sizeably with the use of 20 kg N/ha and it was increased to the tune of 14.15 % higher over control treatment. Further an increase in nitrogen level upto 30 kg /ha being produced more number of leaves/plant than 20 kg N/ha. With each successive level of nitrogen from 0 to 20 kg/ha resulted significant enhancement in number of branches /plant. But the difference between 20 and 30 kg N/ha levels of nitrogen was comparable in case of branches /plant. Dry matter production per meter row length was affected significantly with increasing in supply of nitrogen. This might be due to nitrogen promote hasten growth in terms of higher plant height, more number of leaves/plant and greater number of branches/plant. The results are in close conformity with the findings of Indoria *et al*.2005. Application of nitrogen 30 kg/ha gave the highest green fodder (178.11q/ha) and dry forage yield (36.12 q/ha) and were significantly increased by 3.15, 12.32 and 34.25 in green fodder and 3.76, 14.48 and 32.59 % in dry matter when comparison was made with control, 10kgN and 20kgN /ha on mean values basis.. However, when nitrogen was applied beyond 20 kg/ha had not brought significant differences in green and dry fodder yield over 30 kg N/ha. The lack of response of higher levels of nitrogen might be due to symbiotic nitrogen fixation in the roots of cowpea, which might have made up a part of its requirement. Similar results were also reported by Meena et al 2011. While increase in nitrogen application upto 20kgN/ha have ensured higher crude protein content in cowpea haulm and increased in the tune of 19.71 and 5.88% over control and 10 kg N/ha, respectively.

Table1. Effect of nitrogen and phosphorus levels on growth parameters of cowpea at harvest

Treatment	Plant height at 50% flowering stage (cm)		Number of leaves/plant at harvest		Number of branches/plant at harvest		Dry matter accumulation per meter row length (g)	
	2014	2015	2014	2015	2014	2015	2014	2015
Nitrogen level(kg/ha)								
0	68.25	69.32	19.24	20.34	6.10	6.24	77.1	79.31
10	76.08	78.64	22.07	23.12	7.10	7.36	93.4	96.41

20	79.25	81.73	23.50	24.64	8.10	8.19	102.2	107.24
30	82.07	87.63	24.01	27.32	8.20	8.64	104.4	109.73
C.D.at 5 %	5.13	5.41	1.54	2.16	0.63	0.72	4.90	5.21
Phosphorus (P_2O_5 kg/ha)								
0	68.03	69.21	20.05	21.72	6.10	6.45	76.10	78.56
20	76.41	77.45	22.06	24.14	7.05	7.16	93.00	97.65
40	79.40	81.13	23.20	25.78	8.17	8.34	103.40	109.76
60	81.31	85.31	24.09	27.51	8.20	8.72	106.10	115.54
C.D. 5 %	5.63	6.41	0.74	0.82	0.74	0.79	5.10	6.14

Response to phosphorus: Application of phosphorus revealed that plant height of fodder cowpea was remarkably increased upto 20 kg P_2O_5/ha and representing percent increase by 12.32 and 11.90% over control in respective years (2014 and 2015). Further application of phosphorus upto 60 kg P_2O_5/ha could not enhance the plant height statistically significant over 20 and 40 kg P_2O_5/ha. While number of leaves/plant was increased significant with the application of phosphorus upto 40 kg/ha in the tune of 22.14 and 5.17 % in 2014 and 21.11 and 6.57% in 2015 than control and 20 kg P_2O_5/ha. Branches /plant of fodder cowpea was increased with each successive level of phosphorus upto 60 kg P_2O_5/ha. But the difference was not significant over to 40 kg P_2O_5/ha. Similar trend was also observed in case of dry matter production. This might be due to better growth and development of cowpea which lead to increase in dry matter accumulation. Data in Table 2 indicated that increase in phosphorus level caused significant increase in green and dry forage yields of cowpea only upto 40 P_2O_5/ha and this treatment also gave additional 43.97 and 17.51q/ha green fodder and 8.86 and 3.54 q/ha dry matter over to control and 20 kg P_2O_5/ha, respectively. The percent increase in green fodder 33.89 and 11.21 with 40 P_2O_5/ha over to control and 20 kg P_2O_5/ha. Similarly, the dry fodder production was increased in the tune of 34.46 and 11.40 % higher with the application of 40kg P_2O_5/ha as compared to control and 20 kg P_2O_5 /ha, respectively. However, application of 60 P_2O_5 /ha could not brought significant improvement in green and dry forage production of cowpea over to 40 kgP_2O_5/ha.

Economics: Data on economic evaluation of treatments in terms of gross return, net monetary returns and B: C ratio after application of nitrogen in fodder cowpea gave the highest gross return (Rs. 28896/ha), net return (Rs. 17044/ha) and benefit cost ratio(1.69) under 30 kg N/ha. Further, additional gross return and net profit fetched more in the tune of Rs. 7104 and Rs. 2403/ha over no use of nitrogen. Similarly, application of full dose of phosphorus 60 kg/ha realized higher gross return (Rs. 28668), net profit (Rs. 16720) and B:C ratio(1.71) than other levels of phosphorus(Table2). It may be concluded that maximum green fodder yield of cowpea (194.07 q/ha) could obtain when conjunctive use of 20 kg N and 60 kg P_2O_5/ha with a net profit of Rs.16812/ha under semi-arid condition of Rajasthan.

Table 2. Effect of nitrogen and phosphorus levels on green forage, dry matter, protein content and economics of cowpea

Treatment	Green fodder yield at 50 % flowering (q/ha)		Dry forage yield at 50 % lowering q/ha)		Protein content (%)		Gross return (Rs/h)	Net return (Rs/ha)	Benefit : cost ratio
Nitrogen kg/ha									
	2014	2015	2014	2015	2014	2015	Mean values		
0	130.03	135.32	26.05	28.43	15.03	15.62	21792	14641	1.48
10	155.03	162.12	31.04	32.07	17.10	17.54	25244	16106	1.56
20	170.02	175.32	34.01	35.61	18.06	18.63	27848	16904	1.64
30	174.01	182.21	35.03	37.21	18.41	18.73	28896	17044	1.69
CD at 5 %	8.25	8.53	1.60	1.73	0.65	0.73			
Phosphorus P_2O_5 kg/ha									
0	127.31	132.13	25.21	26.21	16.06	16.56	20568	14951	1.37
20	154.04	158.32	30.65	31.42	17.09	17.53	24828	16170	1.53
40	172.05	175.34	34.33	34.81	18.02	18.55	27656	16853	1.64
60	176.01	182.12	35.24	36.43	18.06	18.65	28668	16720	1.71
CD at 5 %	9.25	9.62	2.09	2.15	0.79	0.82			

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