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Research Article

INFLUENCE OF VAM FUNGI AND PHOSPHORUS MANAGEMENT ON GROWTH, YIELD AND YIELD ATTRIBUTES OF CHICKPEA UNDER CHICKPEA-FODDER SORGHUM CROPPING SEQUENCE OF SOUTH GUJARAT

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Abstract- Field experiments were conducted at the College Farm, N.M. College of Agriculture, Navsari Agricultural University, Navsari during *rabi* and summer seasons of 2014-15 and 2015-16. The treatments comprised for chickpea were two levels and two sources of phosphorus (25 and 50 kg P_2O_5/ha from SSP and rock phosphate) along with and without VAM (*Vesicular arbuscular mycorrhiza*) @ 2.0 kg/ha as soil inoculants and one control *i.e.*, control (No phosphorus and VAM to chickpea) and making ten treatment combinations, laid out in a randomized block design, replicated three times. The succeeding fodder sorghum crop was grown on the same layout, keeping chickpea treatments as main plots and two fertility levels as sub-plots [75 % of the recommended dose of 60 kg N + 30 kg P_2O_5/ha and 100% of the recommended dose of 80 kg N + 40 kg P_2O_5/ha]. Total twenty treatment combinations were in a split plot design (SPD) with three replications. The experiments during both years were conducted on the same site without changing the randomization of treatments. The highest seed and straw yields of chickpea were recorded with 50 kg P_2O_5/ha from SSP with VAM (T_8) and was at par with 50 kg P_2O_5/ha from SSP alone (T_4), 50 kg P_2O_5/ha from RP alone (T_5) and 50 kg P_2O_5/ha from RP + VAM (T_9). The increase in chickpea yields were the results of increased growth and yield attributes viz., plant height, number of branches per plant, dry matter accumulation, number of pods per plant, pod weight per plant, number of grains per plant and 100 seed weight also these all growth and yield attributes were found in accordance with the trend of chickpea yield.

Keywords- Chickpea, Phosphorus, Rock phosphate, SSP, VAM, Yield.

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Introduction

Chickpea is grown in more than 50 countries (89.7% area in Asia, 4.3% in Africa, 2.6% in Oceania, 2.9% in Americas and 0.4% in Europe). India is the largest chickpea producing country accounting for 64% of the global chickpea production [3]. In India, chickpea is grown in 9.92 m ha area and production is about 9.52 m t and yield of 960 kg/ha. In Gujarat, it covers an area of 0.25 m ha with a production of 0.30 m t and an average yield of 1251 kg/ha. In India, chickpea is grown in 9.92 m ha area and production is about 9.52 m t and yield of 960 kg/ha. In Gujarat, it covers an area of 0.25 m ha with a production of 0.30 m t and an average yield of 1251 kg/ha [1].

Materials and Methods

Field experiments were conducted at the College Farm, N.M. College of Agriculture, Navsari Agricultural University, Navsari during *rabi* and summer seasons of 2014-15 and 2015-16. The soil analysis indicated that the soil of the experimental plots was clay in texture (66.52 % and 65.27 %), low in organic carbon (0.47 % and 0.50 %), available nitrogen (211.00 and 219.00 kg/ha) and phosphorus (28.20 and 30.50 kg/ha), high in available potassium (335.80 and 347.50 kg/ha), medium in available sulphur (21.00 and 22.50 kg/ha) and slightly alkaline in reaction (pH 7.7 and 7.6.). The common dose of FYM (10 t/ha) was incorporated in soil before sowing of crop to a depth of 10-15 cm. Chemical fertilizers were applied in the experiment plots uniformly at the time of sowing as basal dose as per the treatments. The common dose of nitrogen was applied through urea and phosphorus was applied through single super phosphate (SSP) and rock phosphate (RP) as per the treatments. VAM (*Vesicular Arbuscular Mycorrhiza*) culture was treated as per the treatments. The treatment consisted of phosphorus management *viz.,* T_1 : Control (0 kg P_2O_5 /ha), T_2 : 25 Kg P_2O_5/ha through SSP, T_3 : 25 Kg P_2O_5/ha through RP, T_4 : 50 Kg P_2O_5/ha through SSP, T_5 : 50 Kg P_2O_5/ha through RP, T_6 : 25 Kg P_2O_5/ha through SSP + VAM, T_7 : 25 Kg P_2O_5/ha through RP + VAM, T_8 : 50 Kg P_2O_5/ha through SSP + VAM, T_9 : 50 Kg P_2O_5/ha through RP + VAM, T_{10} : Only VAM to chickpea in *rabi* season as main plot treatments replicated three times in randomized block design. During summer season each main plot treatment was split into two sub-plot treatments with two levels of recommended dose of fertilizer *viz.,* F_1 : 75 % RDF (60 kg N + 30 kg P_2O_5/ha) and F_2 : 100 % RDF (80 kg N + 40 kg P_2O_5/ha) to fodder sorghum resulting in twenty treatment combinations replicated three times in split plot design. SSP and RP were applied to chickpea crop as per treatments. VAM was mixed with soil of particular bed. Before application of RP, it was analysed for NPK content. The nitrogen was applied through urea, whereas phosphorus was applied through SSP. The half dose of nitrogen and full dose of SSP were applied at the time of sowing, while remaining half dose of nitrogen was applied as top dressing as per treatment.

Results and Discussion

Growth

In order to quantify the response observed due to phosphorus management to the preceding chickpea, the growth attributes were assessed on pooled basis in terms of plant height [Table-1]. Significantly higher plant height, number of branches per

plant, Dry matter production per plant were recorded under the treatment having application of 50 kg P_2O_5/ha from SSP with VAM (T_8) at 60 DAS, 90 DAS and at harvest during both the years as well as in pooled data, respectively. Same treatment remained at par with treatments of application of 50 kg P_2O_5/ha from SSP alone (T_4), 50 kg P_2O_5/ha from RP+VAM (T_9) and 50 kg P_2O_5/ha from RP alone (T_5) at all the growth stages during both the years as well as in pooled data. While Days to 50% flowering was not differed due to these phosphorus management practices. The increase in plant height may be due to the fact that phosphorus is a constituent of the cell nucleus (DNA and RNA) and it is essential for cell division and for development of meristematic tissues. Thus, increase in meristematic activities of the tissue in plant system is bound to increase morphological organs of the plant. Further, phosphorus plays great role in metabolic processes and enzyme reactions responsible for growth and development of pulses crops. The increased dry matter per plant may be attributed to the significant increased in morphological parameters, which were responsible for the photosynthetic capacity of the plant, thereby increasing the biomass production of chickpea. The increase in dry matter production due to application of phosphorus also reported [2,4,6,10].

Table-1 *Influence of VAM fungi and phosphorus management on growth of chickpea under chickpea-fodder sorghum cropping sequence (Pooled data of 2 years).*

Treatments	Plant height (cm)				Number of branches per pant				Days to 50% flowering	Dry matter production per plant (g)			
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest		30 DAS	60 DAS	90 DAS	At harvest
T_1	21.21	24.21	32.5	33.58	8.21	13.02	18.90	21.65	56.69	1.96	6.35	13.14	19.13
T_2	21.59	28.44	34.9	36.06	8.31	14.58	19.15	21.37	56.57	2.34	6.71	14.42	21.37
T_3	21.80	26.33	34.3	35.43	8.59	13.92	18.93	21.43	56.69	2.13	6.51	14.01	20.54
T_4	22.62	35.25	42.5	43.56	8.68	18.71	23.14	26.33	57.72	2.81	7.93	18.00	25.41
T_5	22.41	34.91	41.3	42.41	9.06	17.95	22.17	26.52	57.96	2.77	7.66	17.49	24.98
T_6	21.72	29.31	35.6	36.74	8.16	14.87	19.40	21.55	56.64	2.45	6.82	14.71	21.58
T_7	21.40	27.44	34.5	35.56	8.46	14.21	19.05	21.33	56.74	2.22	6.56	14.28	21.22
T_8	22.98	35.36	42.7	43.80	8.99	18.76	23.29	26.87	57.29	2.91	8.55	18.31	25.84
T_9	22.73	34.96	41.9	42.98	8.94	18.39	22.87	26.32	58.36	2.78	7.78	17.69	25.23
T_{10}	21.43	24.88	33.3	34.36	8.14	13.46	19.07	21.07	56.52	2.00	6.54	13.40	19.93
S.Em.±	0.77	1.14	1.41	1.62	0.34	0.71	0.84	1.03	2.62	0.10	0.32	0.62	0.89
CD at 5 %	NS	3.28	4.05	4.65	NS	2.036	2.41	2.95	NS	0.29	0.90	1.77	2.56
CV %	8.56	9.31	9.26	10.33	9.72	11.02	10.00	10.77	11.25	10.08	10.80	9.71	9.71

Table-2 *Influence of VAM fungi and phosphorus management on yield and yield attributes of chickpea under chickpea-fodder sorghum cropping sequence (Pooled data of 2 years).*

Treatments	No. of pods per plant	Pod weight per plant	No. of grains per pant	100 seed weight (g)	Seed yield (q/ha)	Straw yield (q/ha)
T_1	42.43	12.11	39.81	17.68	13.14	19.59
T_2	45.52	14.01	41.23	19.01	14.42	21.58
T_3	44.50	13.56	40.85	18.74	14.02	21.10
T_4	55.91	17.34	51.96	21.22	18.34	26.22
T_5	54.79	17.03	50.58	20.84	17.55	25.54
T_6	45.91	14.22	41.33	19.14	14.61	21.87
T_7	45.05	13.76	40.96	18.79	14.19	21.19
T_8	56.78	17.75	52.29	21.66	19.38	26.92
T_9	55.10	17.13	50.92	21.11	18.04	25.87
T_{10}	44.01	12.93	40.93	18.41	13.64	20.40
S.Em.±	1.93	0.62	1.96	0.63	0.85	1.01
CD at 5 %	5.54	1.77	5.62	1.80	2.45	2.89
CV %	9.65	10.07	10.64	7.79	13.27	10.7

Yield and yield attributes

Yield is output due to better response of various yield attributes. Most of yield attributing characters *viz*., number of pods per plant, pod weight per plant, number of grains per plant and 100 seed weight were significantly influenced due to effect of phosphorus management applied to chickpea. Application of 50 kg P_2O_5/ha from SSP with VAM (T_8) recorded significantly higher Number of pods per plant, Pod weight per plant, Number of grains per plant and 100 seed weight during both the years of experimentation along with pooled data, respectively and remained at par with treatments receiving 50 kg P_2O_5/ha from SSP alone (T_4), 50 kg P_2O_5/ha from RP + VAM (T_9) and 50 kg P_2O_5/ha from RP alone (T_5). Also same trend was observed in seed and straw yields of chickpea. Phosphorus application increased the photosynthetic and microbial activities and translocation of photosynthates which resulted in higher seed yield. Phosphorus improved growth and fresh and dry weight which might have resulted into increased straw yield. Another possible reason for increased yield of chickpea with phosphorus application may be due to pulse crop and low P status of the soil. The present results are in consonance with those of Tomar*et al*. (1996), [11] Rooge*et al.* (1998),[8] Singh *et al.* (2014),[9] Lal *et al.* (2014), [5] Raj *et al.* (2015) [7] and Yadav *et al.* (2015) [12] who reported significant increased in yield parameters as well as seed and straw yields due to application of phosphorus in chickpea.

Conclusion

On basis of the experimental results, it can be concluded that the farmers following chickpea-fodder sorghum cropping system under *Inceptisols* of South Gujarat should fertilize their chickpea crop with 50 kg P_2O_5/hafrom SSP + Soil inoculation with VAM @ 2.0 kg/haso as to obtain better quality yields and economic returns as well as to sustain the soil fertility in long run.

Conflict of Interest: None declared

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