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Effect of graded saturation of p-fixing capacity of two different soil types on growth and yield of wheat (*Triticum aestivum* L.)

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Abstract
A field experiment was carried out at two different locations, (i) Agronomy farm, B.A.C.A, AAU, Anand and (ii) Tribal Cum Training Research Centre, AAU, Devgadh Baria, Dist. Dahod (Gujarat) to find out the "Effect of graded saturation of P-fixing capacity of two different soil types on growth and yield of wheat (*Triticum aestivum* L.)" during the *rabi* season of the year, 2016-17. The treatment containing application of 100% P-fixing capacity of soil + 50 kg $FeSO_4$ ha^{-1} + 25 kg $ZnSO_4$ ha^{-1} + 60 kg K_2O ha^{-1} along with RDF kg ha^{-1} recorded significantly higher growth attributes like plant as well as yield attribute like number of grain per spikes and grain and straw yield of wheat at both the location.

Keywords: P-fixation, wheat, growth and yield

1. Introduction
Wheat (*Triticum aestivum* L.) is one of the most important extensively grown food crop in the world. It is number one food grain consumed directly by human beings and is estimated that more than 35 per cent of the world population depends on wheat. Wheat is the second important staple food crop in India next to the China, rice being the first. India is the 2nd largest producer of wheat all over the world. Around 12 per cent of wheat produced all over the world is produced in India. Wheat production of India is 93.50 million tones. The average wheat productivity of India is 3093 kg ha^{-1} (Anonymous, 2017) [1] while, in Gujarat wheat is grown over an area of 1.35 million hectares with an annual production of 3.65 million tonnes with the productivity of 2730 kg ha^{-1}. Major wheat growing states in India are Uttar Pradesh, Punjab, Haryana, Rajasthan, Madhya Pradesh, Gujarat, Maharashtra, New Delhi and Bihar. The response to phosphorus application by wheat crops on soils having different P-fixing capacities, application of phosphorus on the basis of soil's phosphorus fixing capacity may help in improving the phosphorus availability in soil and there by its response to phosphorus. Also, high phosphorus application may reduce the availability of Fe and Zn in soil. So this nutrient will also be tried with additional P-fertilization to check the reason of low response of phosphorus. Keeping this fact in mind field experiment was planned at two different locations to investigate the "Effect of graded saturation P-fixing capacity of two different soil types on yield and chemical composition of wheat (*Triticum aestivum* L.)".

2. Material and Methods
The experiment was laid out in a randomized block design with ten treatments which were replicated in a thrice. These ten different treatments are as follows: T_1: Only N (120 kg ha^{-1}), T_2: (Control) NP (120:60:00 kg ha^{-1}RDF), T_3:NPK (120:60:60 kg ha^{-1}), T_4: RDF + P equivalent 50% Phosphorus fixing capacity of the soil, T_5: RDF + P equivalent 75% Phosphorus fixing capacity of the soil, T_6: RDF + P equivalent 100% Phosphorus fixing capacity of the soil, T_7: RDF + P equivalent 100% Phosphorus fixing capacity of the soil + Fe (50 kg $FeSO_4$ ha^{-1}), T_8: RDF + P equivalent 100% Phosphorus fixing capacity of the soil + Zn (25 kg $ZnSO_4$ ha^{-1}), T_9: RDF + P equivalent 100% Phosphorus fixing capacity of the soil + Fe (50 kg $FeSO_4$ ha^{-1}) + Zn (25 kg $ZnSO_4$ ha^{-1}), T_{10}: RDF + P equivalent 100% Phosphorus fixing capacity of the soil + Fe (50 kg $FeSO_4$ ha^{-1}) + Zn (25 kg $ZnSO_4$ ha^{-1}) + K_2O @ 60 kg ha^{-1}. The soil of experiment at Anand field was loamy sand in texture, low in organic carbon, medium in nitrogen and available phosphorus, high in available potassium and deficient in available Zn and Fe Where as Devgadh Baria field soil was clay loam texture, medium in organic carbon,

nitrogen and available phosphorus, high in available potassium and medium in available Zn and high in Fe. The observations were recorded plant height as well as yield attribute like number of grain per spikes of wheat whereas total N content were analyzed by Kjeldahl method and total P, K and S were analyzed by wet-digestion (di-acid) method given by Tandon (1995).

The incubation study was conducted in laboratory with the application of graded amount of inorganic phosphorus in both the soil*s* indicated that the relationship between available and added phosphorus was virtually linear. The percent fixation of phosphorus in the soil came out to 85.94% and 88.33% for the Anand and Devgadh Baria soil, respectively. It may be noted that the Devgadh Baria soil has higher P-fixing capacity than the Anand soil might be due to the more CEC and organic matter in the soil.

3. Result and Discussion

Table 1: Effect of graded saturation of P-fixing capacity on plant height and number of grains per spikes of wheat

Treatments	Plant height (cm) at harvest			Number of grains per spike		
	Anand	Devgadh Baria	Pooled(Y x L)	Anand	Devgadh Baria	Pooled(Y x L)
T_1	75.43	79.30	77.37	32.00	34.40	33.20
T_2	70.53	72.23	71.38	28.93	31.87	30.40
T_3	83.23	85.03	84.13	35.31	39.50	37.41
T_4	78.57	81.90	80.23	32.33	34.93	33.63
T_5	73.40	75.17	74.28	28.47	34.10	31.28
T_6	87.10	90.30	88.70	39.53	41.83	40.68
T_7	82.80	84.43	83.62	35.33	39.30	37.32
T_8	81.23	83.33	82.28	33.67	37.07	35.37
T_9	84.37	86.50	85.43	38.27	40.60	39.43
T_{10}	89.00	91.67	90.33	41.07	42.65	41.86
S.Em±	2.47	2.05	1.44	1.30	1.10	0.806
CD at 5%	7.32	6.08	4.12	3.86	3.26	2.30

The data revealed that treatment T_{10} (RDF + 100% P-fixing capacity of soil + 50 kg $FeSO_4$ ha^{-1} + 25 kg $ZnSO_4$ ha^{-1} + 60 kg K_2O ha^{-1}) recorded significantly highest plant height at harvest of 89.00 cm and 91.67 cm at Anand and Devgadh Baria, respectively, which was at par with treatment T_3, T_6, T_7 and T_9 at both the locations. However, significantly lower values were registered in treatment receiving T_2 (RDF 120-60-00 kg NPK ha^{-1}) in Anand and Devgadh Baria. Plant height due to treatment T_{10} observed 21.75% and 21.21% higher over the RDF (T_2) at Anand and Devgadh Baria, respectively while In pooled plant height at harvest in pooled was also significantly influenced with treatment T_{10} (RDF + 100% P-fixing capacity of soil + 50 kg $FeSO_4$ ha^{-1} +25 kg $ZnSO_4$ ha^{-1} + 60 kg K_2O ha^{-1}) and it was at par with treatment T_6.

Significantly higher number of grains per spike were recorded with treatment T_{10} (RDF + 100% P-fixing capacity of soil + 50 kg $FeSO_4$ ha^{-1} + 25 kg $ZnSO_4$ ha^{-1} + 60 kg K_2O ha^{-1}) compared to other treatments but was remained at par with treatment T_6.

Table 2: Effect of graded saturation of P-fixing capacity on grain and straw yield of wheat

Treatments	Grain yield (kg/ha)			Straw yield (kg/ha)		
	Anand	Devgadh Baria	Pooled (Y x L)	Anand	Devgadh Baria	Pooled (Y x L)
T_1	3223	3990	3607	5220	6096	5640
T_2	3201	3495	3348	4955	5122	5038
T_3	4250	4740	4495	7388	7736	7562
T_4	3620	4189	3904	6055	6651	6353
T_5	3219	3858	3538	5181	5851	5516
T_6	4586	5049	4817	7731	8133	7932
T_7	4136	4652	4394	7223	7531	7377
T_8	3792	4563	4178	6769	7374	7072
T_9	4321	4938	4630	7547	8053	7800
T_{10}	4763	5137	4950	7891	8371	8131
S.Em±	264	236	162	416	466	312
CD at 5%	785	701	462	1235	1384	895

The data presented in Table 2 showed that grain and straw yield of wheat was significantly influenced due to different treatments containing graded saturation of phosphorus fixing capacity at both the locations. Significantly higher grain (4763 and 5137 kg ha^{-1}) and straw (7891 and 8371 kg ha^{-1}) yield were observed due to additional dose of phosphorus with K, Fe and Zn along with RDF (T_{10}: RDF + 100% P-fixing capacity of soil + 50 kg $FeSO_4$ ha^{-1} + 25 kg $ZnSO_4$ ha^{-1}+ 60 kg K_2O ha^{-1}) over rest of the treatments but former treatment found to be at par with treatment T_6. The significant effect of the treatment in increasing grain yield of wheat might be due to positive effect of treatments on growth parameters and yield attributes during growth period (Table 1 and 2). The comparison of yield obtained at both the locations indicated that yield recorded at clay loam soil of Devgadh Baria was more as compared to loamy sand soil of Anand. These might be due to high fertility status of soils at Devgadh Baria. The potassium plays important role in increasing grain and straw yield of wheat as it is associated with opening and closing of stomata, regulate plant turgidity with movement of water, nutrients and carbohydrates in plant tissue also involved in enzyme activation within the plant which affects protein content. Phosphorus also act as accessory structural element and vital for living tissues (Reddy and Reddy, 1992) [6]. The effects of application of Fe and Zn were found not pronounced which might be due to marginal status of Fe & Zn

in soils. These results are in conformity with those of Yuvraj Yaduwanshi (2015) [8], Bashir *et al*. (2015) [2], Shabnam and Iqbal (2016) [7] and Noonari *et al.* (2016) [4] and Chekolle (2017) [3] in wheat.

4. Conclusion

From this field experiment, it can be concluded that application of RDF + 100% P-fixing capacity of soil + 50 kg $FeSO_4$ ha^{-1} + 25 kg $ZnSO_4$ ha^{-1} + 60 kg K_2O ha^{-1}) was found to be most effective for growth like plant height and obtaining higher grain and straw yield of wheat. Hence, it could be conclude that wheat crop should be fertilized with higher rate of P on the basis of P fixing capacity of soil for getting higher yield.

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