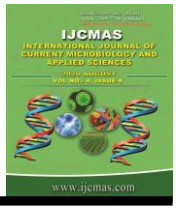
Int.J.Curr.Microbiol.App.Sci (2020) *9*(8): 847-853

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 9 Number 8 (2020)**
Journal homepage: http://www.ijcmas.com



Original Research Article https://doi.org/10.20546/ijcmas.2020.908.091

Effect of levels of Phosphorus and P Solubilization by Spent Wash from Rock Phosphate on Protein, Total Sugar and Total Starch Contain in Grain and Straw of Wheat in an Inceptisol

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A B S T R A C T

Phosphorus is the most important nutrient element for growth and development of wheat. In this field experiment, the effects of Solubilization of rock phosphate by spent wash onprotein, total sugar and total starch content in grain and straw was studied. application of 100% N&K + 75% P through SSP recorded significantly highest protein content in grain and straw found significantly superior to their lower levels. Results further indicate that solubilization of rock phosphate remained at par with RP:SW@1:40 but recorded significantly protein, total sugar and total starch content in grain and straw as compared to remaining levels of rock phosphate and control. The application of RP:SW@1:40 significantly increased the protein, total sugar and total starch content in grain and straw and total uptake. These improvement manifested in highest values of crop productivity in terms of protein, total sugar and total starch content in grain, straw under this treatment. The RP:SW@1:40 recorded the highest protein, total sugar and total starch content in wheat crop.

Keywords

Rock Phosphate, Spent Wash, Protein, Total sugar and Total starch, Wheat

Article Info

Accepted:
10 July 2020
Available Online:
10 August 2020

Introduction

Wheat is second most important crop after rice. It is grown under diverse agro climatic conditions. The world production of wheat figures over 670 million tons annually. The largest producer of wheat in the world is the European Union followed by China, India and United States of America. India occupies area (28.46 million hectares) and production (80.8 million tonnes) of wheat. Uttar Pradesh has highest production (35.03%) of nation and also large area. In Uttar Pradesh has wheat production is 24.5 million tonnes, productivity of 2.7 tonnes/ha and area is 9.2 million ha. The total wheat production of the world is slightly concentrated and is clear from the fact that these four producers contribute to around 60% of the total production. The consumption of wheat in the world is 667 million tons but is kept satisfied with an equally high production figures. Consumption has been constantly increasing during the last 15 years with the increase in population and is prepared to shoot up further to 780 million tonnes in 2020. It has been

estimated that India will need at least 109 million tonnes of wheat by 2020 as against present area of 305.97 lac ha and production of 98.38 million tonnes (Agricultural Statistics at a Glance, 2015-16). Since very little scope exists for horizontal growth, the alternative is to achieve vertical growth through increasing productivity.

Fertilizer is the single most important input in modern agriculture to raise the crop productivity. Phosphorus plays vital role in enhancing maturity and development of seed. Application of phosphorus and potassium fertilizers reduce lodging tendency and support tillering in wheat, improves photosynthesis resulting high grains (Zhang *et al.*, 2010) reported that adequate P application increase of 20% grain yield. Increased P applications resulted in Nitrogen uptake. Chaturvedi (2006) reported that 28.5 kg P ha^{-1} as optimum dose for growth, plant height, grains $spike^{-1}$, tillers, 1000 grain weight, grain and straw yields. Jiang *et al.*, (2006) observed 108 kg P ha^{-1} for higher tillers, leaf area index, ear bearing tillers and dry matter accumulation. Khalid *et al.*, (2004) reported that obtained maximum productive tillers, grain yield and biological yield on application of 45 kg P ha^{-1} in wheat.

Materials and Methods

Field Experiment conducted at Agriculture Research farm Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, followed by laboratory analysis of the plant and grain samples in the Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. Experiment located between $25^0$18' North latitude and 80^0 36' East longitude. Climate condition was semi-arid to sub humid climate with moisture deficit index between 20-40. The annual rainfall of this region is about 1100 mm. Generally, the maximum and minimum temperature ranged between 20 - 42°C and 9 - 28°C, respectively. The total protein was estimated in this supernatent by folin reagent by the method Lowry *et al.*, (1951). Estimation of starch and total sugar content by anthrone reagent in the plant samples was measured by following the method as proposed by Hedge and Hofreiter (1962). Experiment data was statistical analysis by following the Split Plot Design (SPD) to draw the valid differences among the treatments using SPSS software.

Results and Discussion

Protein content

Levels of phosphorus

A critical scrutiny of the data (Table 1) pertaining to protein content in grain and straw indicate that protein content increased significantly with increasing level of phosphorus in A_3 (100% RD of N & K +75% P through SSP) during both the years as well as in pooled analysis. Application of A_3 increased the protein content in grain to the extent of 7.96 and 2.93, 7.58 and 3.45, 7.67 and 3.23 per cent and in straw, the increase was 8.18 and 3.56, 11.28 and 4.96, 10.11 and 4.26 per cent over A_1 and A_2, respectively. While, the level A_4 and A_5 found at par with each other.

Solubilization of rock phosphate

It is evident from the data presented in Table 1 that the increasing level of applied rock phosphate significantly increased the protein content in grain and straw during both the years as well as in pooled analysis. Application of B_3 increased the protein content in grain by 32.49 and 16.26, 34.33 and 13.90, 33.46 and 15.10 per cent over B_1 and B_2, respectively. The corresponding

increase in case of straw was 30.34 and 3.74, 29.41 and 4.41, 30.08 and 4.07 per cent over B_1 and B_2, respectively during both the years and in pooled analysis. However, it was statistically remained at par with B_4.

Total sugar content

Levels of phosphorus

The critical examination of data (Table 2) revealed that application of phosphorus the total sugar content of grain and straw was not affected significantly due to application of phosphorus levels under both the years as well as in pooled analysis.

Solubilization of rock phosphate

It is evident from the data presented in Table 2 that the increasing level of applied rock phosphate significantly increased the total sugar content in grain and straw during both the years as well as in pooled analysis. Application of B_3 increased the total sugar content in grain by 57.83 and 20.19, 58.99 and 20.29, 58.41 and 20.24 per cent over B_1 and B_2, respectively. The corresponding increase in case of straw was 98.79 and 29.13, 87.78 and 26.12, 94.19 and 27.48 per cent over B_1 and B_2, respectively during both the years and in pooled analysis. However, it was statistically remained at par with B_4.

Table.1 Effect of levels of Phosphorus and P solubilization by Spent Wash from Rock Phosphate onProtein content of wheat

Treatments	Protein content					
	Grain			Straw		
	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled
Main plot						
A_1 Control (Absolute)	11.72	12.00	11.86	2.69	2.66	2.67
A_2 100% RD of N & K +50% P through SSP	12.27	12.48	12.37	2.81	2.82	2.82
A_3 100% RD of N & K +75% P through SSP	12.63	12.91	12.77	2.91	2.96	2.94
A_4 100% RD of N & K +75% P through RP	12.44	12.79	12.62	2.88	2.93	2.90
A_5 100% RD of N & K +100% P through RP	12.54	12.84	12.69	2.90	2.94	2.92
SEm±	0.07	0.08	0.06	0.03	0.04	0.03
CD (p=0.05)	0.24	0.27	0.16	0.10	0.14	0.08
CV (%)	2.05	2.32	2.19	3.79	5.40	4.67
Sub plot						
B_1 No SW	10.31	10.37	10.34	2.34	2.38	2.36
B_2 RP:SW @ 1:10	11.75	12.23	11.99	2.94	2.95	2.95
B_3 RP:SW @ 1:40	13.66	13.93	13.80	3.05	3.08	3.07
B_4 RP:SW@ 1:80	13.56	13.88	13.72	3.01	3.05	3.03
SEm±	0.06	0.06	0.05	0.02	0.03	0.02
CD (p=0.05)	0.17	0.18	0.13	0.05	0.07	0.05
CV (%)	1.87	2.16	2.32	2.31	3.85	3.99

Table.2 Effect of levels of Phosphorus and P solubilization by Spent Wash from Rock Phosphate on Total Sugar of wheat

Treatments	Total sugar content					
	Grain			Straw		
	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled
Main plot						
A_1 Control (Absolute)	4.16	4.20	4.18	1.29	1.33	1.31
A_2 100% RD of N & K +50% P through SSP	4.25	4.33	4.29	1.30	1.38	1.34
A_3 100% RD of N & K +75% P through SSP	4.31	4.40	4.36	1.40	1.44	1.42
A_4 100% RD of N & K +75% P through RP	4.25	4.35	4.30	1.34	1.41	1.37
A_5 100% RD of N & K +100% P through RP	4.29	4.39	4.34	1.36	1.42	1.39
SEm±	0.09	0.10	0.07	0.03	0.03	0.02
CD (p=0.05)	NS	NS	NS	NS	NS	NS
CV (%)	7.72	8.28	8.01	8.63	7.69	8.16
Sub plot						
B_1 No SW	3.13	3.17	3.15	0.82	0.90	0.86
B_2 RP:SW @ 1:10	4.11	4.19	4.15	1.27	1.34	1.31
B_3 RP:SW @ 1:40	4.94	5.04	4.99	1.64	1.69	1.67
B_4 RP:SW@ 1:80	4.82	4.95	4.89	1.61	1.65	1.63
SEm±	0.06	0.06	0.05	0.02	0.02	0.02
CD (p=0.05)	0.17	0.17	0.14	0.05	0.06	0.05
CV (%)	5.40	5.93	7.02	5.27	6.17	7.13

Table.3 Effect of levels of Phosphorus and P solubilization by Spent Wash from Rock Phosphate on Total Starch of wheat

Treatments	Total starch content					
	Grain			Straw		
	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled
Main plot						
A_1 Control (Absolute)	68.75	69.09	68.92	1.44	1.51	1.47
A_2 100% RD of N & K +50% P through SSP	69.27	70.02	69.64	1.46	1.54	1.50
A_3 100% RD of N & K +75% P through SSP	69.68	70.42	70.05	1.54	1.61	1.58
A_4 100% RD of N & K +75% P through RP	69.34	69.95	69.64	1.50	1.55	1.52
A_5 100% RD of N & K +100% P through RP	69.64	70.32	69.98	1.52	1.58	1.55
SEm±	1.42	1.64	1.08	0.03	0.04	0.02
CD (p=0.05)	NS	NS	NS	0.11	0.11	0.07
CV (%)	7.07	8.13	7.62	7.98	7.91	7.94
Sub plot						
B_1 No SW	65.11	65.94	65.53	0.87	0.95	0.91
B_2 RP:SW @ 1:10	68.78	69.34	69.06	1.41	1.46	1.44
B_3 RP:SW @ 1:40	72.30	72.46	72.38	1.86	1.92	1.89
B_4 RP:SW@ 1:80	71.14	72.09	71.62	1.83	1.90	1.87
SEm±	1.15	1.04	0.87	0.02	0.02	0.02
CD (p=0.05)	3.31	2.98	2.43	0.05	0.05	0.05
CV (%)	6.40	6.29	7.47	4.92	4.95	6.42

Fig.1 Effect of levels of Phosphorus and P solubilization by Spent Wash from Rock Phosphate on protein content in grain and straw of wheat (Pooled mean)

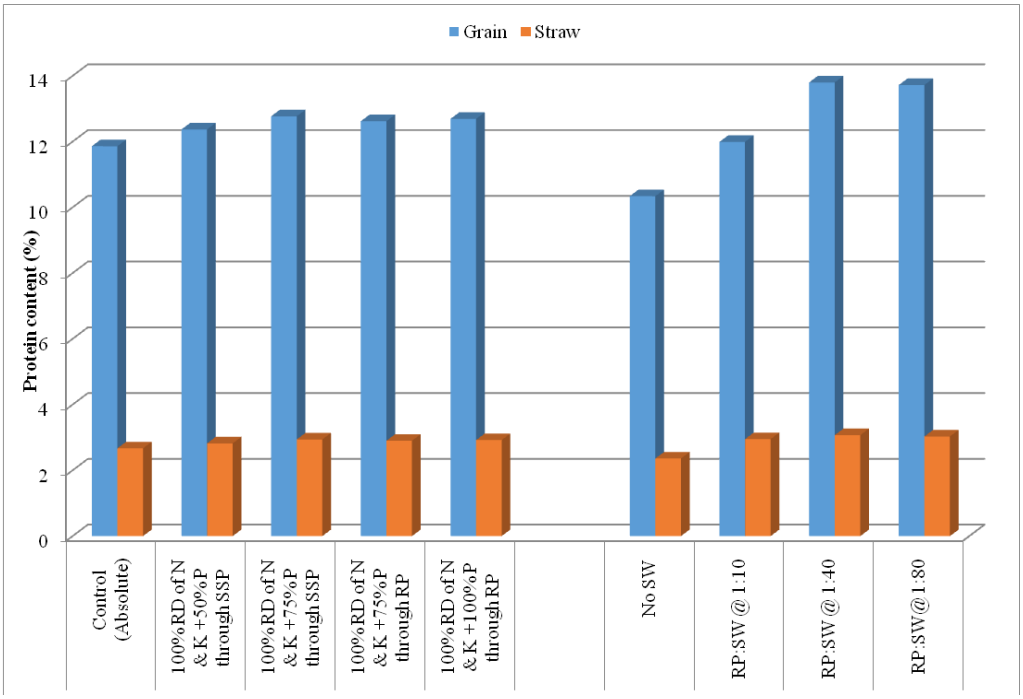


Fig.2 Effect of levels of Phosphorus and P solubilization by Spent Wash from Rock Phosphate on total sugar content in grain and straw of wheat (Pooled mean)

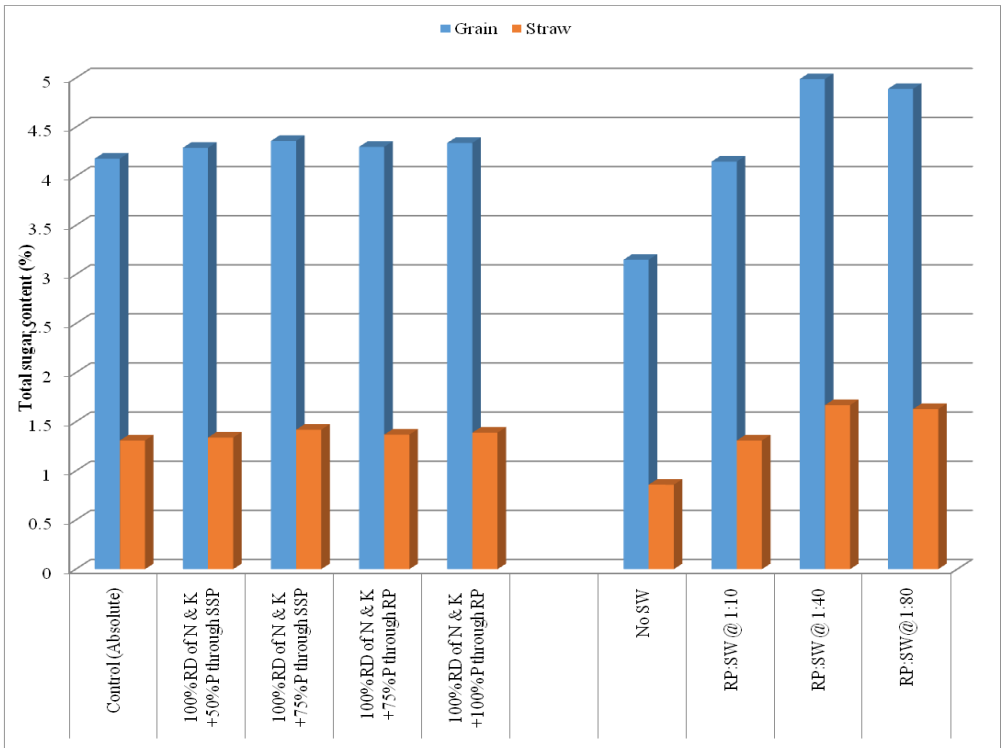
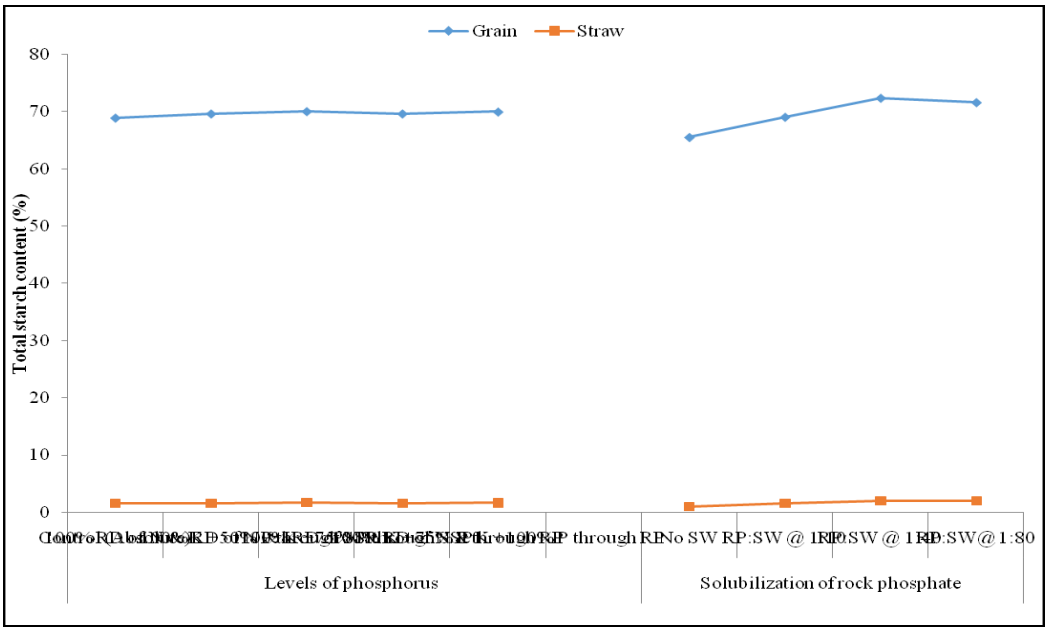


Fig.3 Effect of levels of Phosphorus and P solubilization by Spent Wash from Rock Phosphate on total starch content in grain and straw of wheat (Pooled mean)



Total starch content

Levels of phosphorus

The critical examination of data (Table 3) revealed that application of phosphorus the total strach content in grain and straw was not affected significantly due to application of phosphorus levels under both the years as well as in pooled analysis.

Solubilization of rock phosphate

It is evident from the data presented in Table 3 that the increasing level of applied rock phosphate significantly increased the total starch content in grain and straw during both the years as well as in pooled analysis. Application of B_3 increased the total starch content in grain by 11.04 and 5.12, 9.89 and 4.50, 10.45 and 4.81 per cent over B_1 and B_2, respectively. The corresponding increase in case of straw was 113.79 and 31.91, 102.11 and 31.51, 107.69 and 31.25 per cent over B_1 and B_2, respectively during both the years and in pooled analysis. However, it was statistically remained at par with B_4.

Acknowledgment

The authors are thankful to the head Department of Soil Science & Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi for providing necessary facilities to conduct this research work.

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How to cite this article:

Balu Ram, Ramawatar Meena and Rajkumar Meena. 2020. Effect of levels of Phosphorus and P Solubilization by Spent Wash from Rock Phosphate on Protein, Total Sugar and Total Starch Contain in Grain and Straw of Wheat in an Inceptisol. *Int.J.Curr.Microbiol.App.Sci.* 9(08): 847-853. doi: https://doi.org/10.20546/ijcmas.2020.908.091