International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(5): 3300-3302

Received: 10-07-2019
Accepted: 13-08-2019

Maruthi NG
Department of Soil Science and Agricultural Chemistry, Dr. Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

Ranshur NJ
Department of Soil Science and Agricultural Chemistry, Dr. Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

Lakshmi Prasanna Koncha
Department of Soil Science and Agricultural Chemistry, Dr. Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

Darshana B Kadam
Department of Soil Science and Agricultural Chemistry, Dr. Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

Pratiksha Pawar
Department of Soil Science and Agricultural Chemistry, Dr. Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

Corresponding Author:
Maruthi NG
Department of Soil Science and Agricultural Chemistry, Dr. Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

Quantity/Intensity relationship as influenced by phosphate application by wheat

Maruthi NG, Ranshur NJ, Lakshmi Prasanna Koncha, Darshana B Kadam and Pratiksha Pawar

Abstract
The field experiments were conducted on wheat in rabi during the year 2017-18 at the Instructional Farm of Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, in order to study the "Quantity/Intensity relationship as influenced by phosphate application by wheat". The experiment was laid out in Randomised block design, with seven levels of phosphorus (0, 15, 30, 45, 60, 75 and 90 kg P_2O_5 ha^{-1}) with 3 replications. The results revealed that with increase in the phosphate levels, there was also increase in the quantity of phosphorus in the soil under the treatments applying 0,15,30,45,60,75 and 90 kg P_2O_5 ha^{-1} (T_7), 0.32 Q_o ($X10^{-7}$ mol g^{-1} soil), 27 Ie ($X10^{-7}$ mol L^{-1}), 6.38 EPP, 17 PBC (L g^{-1} soil), the quantity (Qo), intensity (Ie) and capacity factors were improved which resulted in more availability of P in soil, which would serve as a balance for next crop.

Keywords: Wheat, Quantity, Intensity relationship

Introduction
Wheat is a grass widely cultivated for its seed, cereal grain which is a worldwide staple food. Many species of wheat together make up the genus Triticum; the most widely grown is common wheat (*T. aestivum*). India ranks second for wheat cultivation in the world. The major wheat producing states are Uttara Pradesh, Punjab, Haryana, Madhya Pradesh, Rajasthan, Gujarat and Maharashtra. During the year 2018, the area under wheat cultivation in India was 29.585 mha with production of 99.7 MT with an average productivity of 3371 kg ha^{-1}. In Maharashtra, the area under wheat crop is 3.04 M ha and production is 9.22 MT with the average yield of 3034 kg ha^{-1}. In Indian soil, the total phosphorus content ranges from 0.006-0.5%. Soil phosphorus-plant system can be characterised by quantity and intensity factors. Quantity factor is defined as the amount of P that is associated with the soil solid phase which would readily equilibrated with this isotope in the same ionic form. The intensity factor can be defined as the activity of P in soil solution and readily available to the plant (Muralidharudu and Omanwar, 1987) [1]. Schofield (1955) [6] introduced the concept of intensity (Phosphate potential) and subsequently others (Beckett and White, 1964) [2] developed the concept of phosphate potential. Schofield (1955) [6] suggested the chemical potential of phosphate ion in the soil Schofield (1955) [6] further pointed out that even if two soils exhibited the same chemical potential, they might differ in their ability to maintain the potential against depletion of phosphate. Beckett and White (1964) [2] proposed that phosphate potential or $^{a}H_2PO_4$ can be used as an intensity factor while defining Q/I relationships. They introduced the concept of potential buffering capacity (PBC) of soils which is the relation between the phosphate gained or lost by the soil during equilibration and phosphate activity at equilibrium. It is the slope of Q/I curve.

Material and method
The field experiments was conducted on wheat in rabi during the year 2017-2018 at the of Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri. The experimental plot had a plain topography, with soil of medium depth and having good drainage. The soil was medium black in colour with pH 8.09, EC 0.33 dS m^{-1}, containing available N (180.91 kg ha^{-1}), available P (16.26 kg ha^{-1}), available K (495.3 kg ha^{-1}). The status of calcium carbonate (0.511%). The experiment was planned with 7 treatments and 3 replications. The treatments of field study are T_1 : Absolute control, T_2 : GRDF of N & K_2O + 15 kg P_2O_5 ha^{-1}, T_3 : GRDF of

N & K_2O + 30 kg P_2O_5 ha^{-1}, T_4 : GRDF of N & K_2O + 45 kg P_2O_5 ha^{-1},T_5: GRDF of N & K_2O + 60 kg P_2O_5 ha^{-1}, T_6 : GRDF of N & K_2O + 75 kg P_2O_5 ha^{-1}, T_7 : GRDF of N & K_2O + 90 kg P_2O_5 ha-1 Wheat was sown on 06.12.2017 with a spacing of 22.5 cm. All the recommended Agronomic practices were adopted. Phosphorous fractions was determined by Chang and Jackson (1958) [5].

Results and discussion

4.2 Quantity/Intensity parameters in soil as influenced by phosphate application to wheat

The availability of phosphate to plants is generally considered as a function of its intensity, quantity and capacity factors. The capacity factor measures the ability of soil to replenish the nutrient pool and is measured by the ratio of Q/I. Phosphate potential is a measure of the intensity factor, which is measured as (1/2 aCa + aH2P04) or as Scholfield's phosphate potential (Biswas *et al*., (1979). The data on Q/I relationship of phosphorus in soil after harvest of wheat are given in Table 5. The data in respect of Q/I parameters viz., quantity factor (Qo), intensity factor (le), equilibrium phosphate potential (EPP) and potential buffering capacity (PBC) were highly significant.

Table 5: Influence of P application on the Q/I parameters in soil after the harvest of wheat

Treatments	P_2O_5 levels for wheat (kg ha^{-1})	Q_o (X10^{-7} mol g^{-1} soil)	I_e (X10^{-7} mol L^{-1})	EPP	PBC (L g^{-1} soil)
T_1	0	0.14	6	6.6	38
T_2	15	0.16	9	6.54	35
T_3	30	0.20	13	6.51	30
T_4	45	0.22	15	6.46	26
T_5	60	0.25	19	6.43	22
T_6	75	0.28	22	6.4	19
T_7	90	0.32	27	6.38	17
	SE±	0.01	0.55	0.01	0.57
	CD (5%)	0.02	1.69	0.04	1.76

1. Quantity factor: In the present study, Qo is considered as the quantity factor which is ΔP (loss or gain of phosphorus to soil when aH2P04 is 0). The approach developed by Beckett and White (1964) [2] was used for studying Q/I relationship of phosphorus in soil. The data given in Table 1. revealed that with increase in the phosphate levels, there was also increase in the quantity of phosphorus in the soil i.e., 0.14, 0.16,0.20,0.22,0.25,0.28 and 0.32 x 10-7 mol g-1 soil under the treatments applying 0,15,30,45,60,75 and 90 kg P2O5 ha-1 (T7) after the harvest of wheat, respectively. The highest quantity of P was observed in 90 kg P205 ha-1 followed by 75 kg P2O5 ha-1(T6). The treatment 90 kg P205 ha-1 was significantly superior to rest of the levels of phosphorus. Similar results were reported by Muralidharudu and Omanwar (1987) [1].

2. Intensity factor (Ie): Intensity factor (Ie) is the activity of H2P04, where Δ P = 0 is taken as the intensity factor in this investigation. As there is very minor change in concentration of calcium, the phosphate potential can also be used as the intensity factor. The equilibrium phosphate potential (EPP) values, therefore, calculated from Ie values as per the procedure of Beckett and White (1964) [2].The data in Table 5 revealed that Ie values increased with application of phosphorus. The intensity values (Ie) determined after the analysis of soil samples after harvest of wheat were 6,9,13,15,19,22 and 27 x10-7 mol L-1 for the treatments T1 to T7 respectively. The treatment T7 (90 kg P2O5 ha-1) showed the highest intensity of supply of phosphorus and which was significantly superior to all the treatment. Holford and Mattingly (1976) reported that there was consistent increase in the intensity factor for each increment of P fertilizer. They reported an increase in P intensity with the application of fertilizer P.

3. Equilibrium phosphate potential (EPP): The equilibrium phosphate potential of a soil after harvest of wheat was calculated and the data are presented in Table 1. The results indicated that the treatment T1 recorded highest equilibrium phosphate potential (6.6) which decreased with increase in the phosphorus levels as compared to other levels of phosphorus applied. The lowest EPP of P was recorded in treatment T7. Datta and Laskar (1993) [5] also reported similar decline in EPP.

4. Potential buffering capacity (PBC): of P The result of PBC is presented in table 1. It was inferred from the data that the potential buffering capacity was highest in the T1 treatment (38 L g-1 soil) which decreased according to the increased phosphorus treatment levels. The results with respect to PBC were significant, control treatment being significantly superior to all the other treatments which were supplied with phosphate fertilizers. The lowest PBC of P was recorded in treatment T7. Which was significantly lower as compared to other treatments. The data and the discussion on Q/I parameters indicated that though these soils have adequate levels of available P, its particular behaviour in the period of wheat growth may be responsible for the response to applied P fertilizer. The 90 kg P_2O_5 ha^{-1} level indicate optimum/higher intensity factor which may be responsible for higher P availability in soil solution which resulted in higher P uptake and ultimately the yield. The values of ΔP and $^aH_2PO_4$ are given in Appendix I & II. The potential buffering capacity or the capacity factor was characterized from the plot of Δ P against $^aH_2PO_4$. Beckett and White (1964) [2] developed this concept and was used by Muralidharudu and Omanwar (1987) [1].

Conclusion

1. With increase in phosphate levels there was increase in the quantity factor. The treatment T_7 (0.32X 10^{-7} mol g^{-1} soil) showed the highest result than other treatments.
2. Intensity factors increases with increase in phosphate levels. The treatment T_7 (27X 10^{-7} mol L^{-1}) showed the highest result than other treatments.
3. Equilibrium phosphate potential (EPP) decreases with increasing phosphate levels. The control tratments show highest result.
4. Potential buffering capacity (PBC) of soil P decreases with increases in phosphate levels. Contro treatment shows highest result than other treatments.

Reference

1. Muralidharudu Y, CSmanwar PK. Quantity-Intensity relationships of phosphorus in some soils of Uttar Pradesh. Journal of the Indian Society of Soil Science. 1987; 35:619-623.
2. Beckett PHT, White RE. Studies on soil potassium-II. The immediate Q/I relations of labile potassium in the soil. Journal of Soil Science. 1964; 15:1-8.
3. Holford ICR, Matingly GEG. Phosphate adsorption and availability to plant of phosphate. Plant and Soil 1976; 44:377-389.
4. Biswas TD, Sharma JS, Om Dutta. Phosphorus in maintaining soil physical conditions and soil productivity. Journal of Indian Society of Soil Science. 1979; 12:23-29.
5. Chang SC, Jackson ML. Soil phosphorus fractions in some representative soils. Journal of Soil Science, 1958; (9):109-119.
6. Datta M, Laskar S. Response of green gram to P application in some ultisols of Tripura. National Seminar on Development in Soil Science at 58th Annual Convention of Indian Society of Soil Science October. 1993; 8(12):117-118.
7. Schofield RK. Can a precise meaning be given to available soil phosphorus Soils and Fertility. 1955; 18(5):311-373.