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Residual Effect of Phosphorus on Grain Yield of Maize in Pawe District of North Western Ethiopia

Wubayehu Gebremedihn[1] Getachew Yilma[1] Mamo Bekele[2] Mesfin Kuma[3]
1. Ethiopian Institute of Agricultural Research, Fogera National Rice Research and training Center, P.O. Box: 1937 Woreta, Ethiopia
2. Ethiopian Institute of Agricultural Research, Holeta National Biotechnology Research Center, - P.O. Box: 429 Holeta, Ethiopia
3. Ethiopian Institute of Agricultural Research, Pawe Agricultural Research Center, P.O. Box: 25 Pawe, Ethiopia
Email: - getachewmk@gmail.com

Abstract
Phosphorus is an important nutrient element in crop productivity. Maize is one of the common stable food cereal crop grown in different parts of Ethiopia and mostly affected by phosphorous nutrient. An experiment was conducted to evaluate the effects of different levels of residual P for three consecutive years (0, 20, 40, and 80 kg ha^{-1}) in Pawe agricultural research center. At the fourth year by applying 0, 10, 20, and 30 kg ha^{-1} of P final experiment was conducted. the highest grain yield 8359 kg/ha was recorded from the interaction R12P3 which means a residual of 0, 40, 20, 20 kg P/ha for four consecutive years and 20 kg/ha at the experimental year. Over application of P from the previous seasons significantly affects the yield of maize in the experiment year regardless of the current dosage. So the experiment indicates that over accumulation of P affects the growth and yield of maize.
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1. Introduction

Phosphorus is one of the most important elements in a living entity. in plants it is also associated with shooting organs, energy generation, synthesis of nucleic acid, photosynthesis, and respiration of crops (Vance, C. P., et al., 2003). Soil P level is one of the major yield limiting factor in agriculture (Ringeval, B.,et al., 2021). Phosphate fertilizers are usually applied for the better achieving optimal crop grain yield. But, grain yield increase due to the effect of fresh P fertilizer application is determined mainly by different factors. These are plant-available P in the soil, soil pH value, soil organic matter, type of fertilizer, and crop type. So the exact amount of P fertilizer has less importance (Buczko et.al, 2018).

Maize is one of the common stable food cereal crop grown in different parts of Ethiopia and mostly affected by phosphorous nutrient limitation and need sufficient amount of phosphorous application from synthetic fertilizer in order to fulfill the demand for maize grain in the future (Macauley, H., & Ramadjita, T. (2015)

However, sometimes application of phosphorous above 20mg/kg, Olsen-P builds up soil P status which is toxic to the soil and soil microbial biotaaswell as may not be economical. It also increase the risk of environmental problem associated to the loss of P from agricultural land and cause to eutrophication of surface waters reference. The residual effect of P should be taken in to account in the recommendation of phosphorous fertilizer rate and time of application. Farmers who build up soil P in the previous years could omit P fertilizer application from 3-5 years without yield loss. But, those who do not build up soil fertility must apply P fertilizer directly each year the required amount (Aulakh et.al, 2018).

The source of phosphorous used and tillage system also affect the residual level of phosphorous.Reactive rock phosphate (RRP) was reported as the best with no tillage for better residual P in the soil (Oliveira et.al, 2019).

The effect of residual P is not always positive. Sometimes it may have harmful effect by enhancing soil acidity, establishing unfavorable nutrient balance or excessive quantities of secondary nutrients may be left in the soil (Cook et.al, 1957). The objective of this study was to evaluate the effect of residual P on grain yield and yield parameters of maize and phosphorous level on soil acidity and available phosphorous in the soil.

2. Materials and Methodology

2.1. Description of the study area

The activity was done in Metekel zone of Benishangul Gumuz region in Pawe district during the rainy season of 2019 Pawe is about 570 km far form Addis Ababa to the North West direction. It is a humid tropical rain forest region with annual rain fall of about 1500 ml. The altitude of the area is about 1000 m.a.s.l. and the average maximum and minimum temperatures are 26 and 38 respectively.

2.2. Site selection, Land Preparation, other agronomic practices

An experimental site which is 0.56 ha of land was selected, land preparation was done following the conventional practice to make the field suitable for planting during May and early June followed by sawn finger millet to homogenize the farm. in the second year it was divided into four plots of land and the same crop was planted by applying 0, 20, 40, and 80 kg P/ ha from Tri-Super Phosphate and the same amount of nitrogen on each quarter. In the third year each quarter was also divided in to another quarter to have a total of 16 plots on the farm. The same amount of P (0, 20, 40, and 80 kg/ha) was also added to the sub quarter by keeping nitrogen similar to all 16 plots. In the fourth year the same plot and phosphorous level were applied to create more gradient but only the crop type was changed from rice to finger millet. The last year's experiment was done on the fifth year by considering each one sixteenth plot as a single farm with different residual P history. Five levels of Phosphorous (0, 10, 20, 30, 40) kg/ha were used as final treatments to evaluate the residual effect of P on maize grain yield and available P in the soil. The source of the test crop maize (BH-540variety) was from pawe agricultural research center which exists in the hands of breeder and it was planted at a density of 44444/hectare which have space of intra and inter row space 30 and 75cm respectively. This experimental activity was laid down in RCBD design with three replication.

The same amount of nitrogen fertilizer was added in each year on each plot.

Fig. 1 Residual levels of each block (R) in three consecutive years

Block number	P level in 3 consecutive years	Block number	P level in 3 consecutive years
R1	0, 0, 0	R9	80, 0, 0
R2	0, 20, 20	R10	80, 20, 20
R3	20, 0, 0	R11	40, 0, 0
R4	20, 20, 20	R12	40, 20, 20
R5	20, 40, 40	R13	40, 40, 40
R6	20, 80, 80,	R14	40, 80, 80
R7	0, 40, 40	R15	80, 40, 40
R8	0, 80, 80	R16	80, 80, 80

2.3. Soil sample collection and laboratory analyzing procedures

An auger was used to gather representative soil samples to a depth of 20 cm from each spots of each block before and after planting in a diagonal manner. The composite soil samples were air-dried, crushed, and passed through a 2-mm sieve before being thoroughly mixed and analyzed for phosphorus availability test which was determined using the standard Olsen extraction methods (Olsen et al., 1954) while soil pH parameters (Potentiometric method using a glass-calomel combination electrode was used to measure pH of the soils in water suspension in a 1:2.5 (soil: liquid ratio) (Van Reeuwijk, 1992) at Soil Laboratory of Pawe Agricultural Research Center

2.4. Sampling procedure and agronomic data collection

Plant counts were taken 4 to 6wk after planting to assure that each plot was within the desired plant populations. All agronomic data such as plant height, cob length, number of cob per plant, biomass yield and grain yield were taken at harvesting time.

2.5. Statistical data analysis

Effect of different level of P on different parameters of maize was evaluated by analyses of variance (ANOVA), using the statistical analysis system version 9.1 (SAS, 2004) software. Fisher's least significant difference (LSD) test at 5% levels of significance was used to separate the treatment means.

3. Result and Discussion

3.1. The effect of residual P on soil P and PH

Regardless of the previous residual P on the final year of experiment due to the application of P from 0 to 30 with 10 kg ha^{-1} interval, the available P in the soil was increased linearly with equation of $Y = 0.054X + 4.33$. It was increased from 4.33 to 5.95 ppm. But when more P (40) is added, the curve is bended down this might be due to . The PH of the soil was a bit constant in the final year. This was might be due to the quick lime (CaO) effect which was added based on the exchangeable acidity during sowing of maize at the final year. According to the findings of Rowell,A.W.G (1981), application of quick lime affect the soil pH due to the CaO affect soil acidity through neutralizing soil acidity and raising the soil pH mechanisms. When lime combines with water it becomes a basic substances called lime water. This basic substance has the ability to neutralize acidic soil. As lime dissolves in the soil, calcium (Ca) moves to the surface of soil particles, replacing the acidity. The acidity reacts with the carbonate (CO_3) to form carbon dioxide (CO_2) and water (H_2O). The result is a soil that is less

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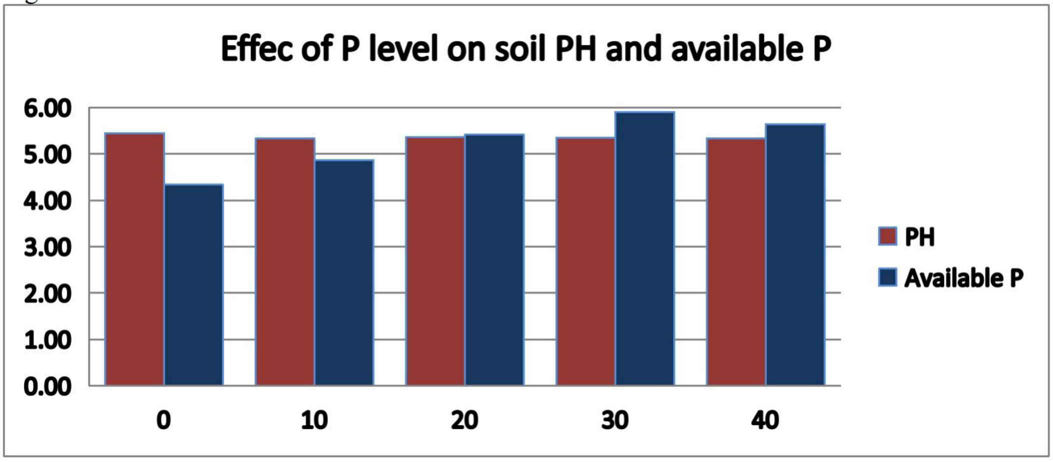
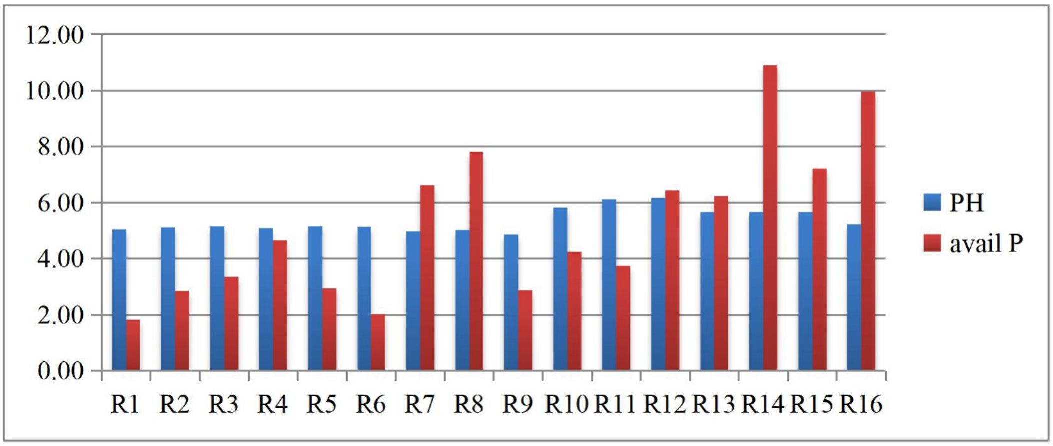
acidic (has a higher PH). Similarly, the addition of calcium oxide or calcium-magnesium oxide enables the acidity of soil to be to neutralized by adjusting pH, which helps to: Prepare the soil for the crop to absorb the nutrients in excellent conditions. it improves water penetration for acidic soils. it improves the uptake of major plant nutrients (nitrogen, phosphorus, and potassium) of plants growing on acid soils.

Fig. 2 The effect of Residual level of P on soil P and PH





3.2. The effect of residual phosphorus on crop yield

Fig 3. Interaction between P and residual phosphorus

Trt	PH	CL	CpP	Bmy	Gy	Trt	PH	CL	CpP	Bmy	Gy
R12P3	239.3^{a-o}	20.0^{b-i}	1.04^{a-i}	26111^{ab}	8359^{a}	R14P2	223.0^{h-x}	19.0^{c-k}	0.98^{c-r}	19630^{c-u}	6355^{b-r}
R12P5	258.0^{a-c}	20.0^{b-i}	1.07^{a-d}	26667^{a}	8222^{ab}	R4P1	243.3^{a-k}	20.7^{a-g}	0.95^{f-r}	22963^{a-l}	6341^{b-r}
R13P4	242.7^{a-l}	22.3^{a-d}	1.14^{a}	24815^{a-f}	8025^{a-c}	R11P4	237.7^{a-p}	19.3^{b-k}	1.01^{b-n}	21111^{a-r}	6308^{b-r}
R13P5	240.7^{a-n}	20.3^{a-h}	0.97^{c-r}	24444^{a-g}	7910^{a-d}	R8P3	228.0^{e-t}	15.3^{k-q}	0.98^{c-r}	21111^{a-r}	6265^{c-s}
R4P4	234.0^{b-r}	20.3^{a-h}	1.04^{a-j}	23889^{a-i}	7893^{a-d}	R9P5	229.7^{d-s}	20.3^{a-h}	0.96^{d-r}	20185^{b-t}	6215^{c-t}
R12P2	232.0^{c-r}	18.3^{d-m}	1.06^{a-e}	25185^{a-e}	7839^{a-e}	R16P4	210.3^{q-z}	16.3^{h-p}	0.93^{j-r}	17407^{j-v}	6056^{d-u}
R8P5	238.7^{a-o}	18.0^{e-m}	0.99^{b-q}	26296^{ab}	7763^{a-f}	R2P2	220.0^{k-x}	17.0^{g-o}	0.95^{e-r}	24629^{a-g}	6025^{d-u}
R13P3	249.0^{a-i}	23.3^{a-b}	1.05^{a-h}	22963^{a-l}	7752^{a-f}	R7P4	239.3^{a-o}	18.3^{d-m}	0.96^{d-r}	20371^{a-s}	6007^{d-u}
R12P4	244.7^{a-k}	20.0^{b-i}	1.05^{a-g}	25555^{a-d}	7742^{a-g}	R10P5	214.0^{n-z}	15.7^{j-p}	0.89^{qr}	21111^{a-r}	5950^{e-u}
R5P4	240.7^{a-n}	20.0^{b-i}	0.97^{c-r}	24074^{a-i}	7705^{a-g}	R10P4	227.7^{f-t}	18.0^{e-m}	0.91^{n-r}	20371^{a-s}	5899^{f-u}
R3P5	253.7^{a-f}	19.7^{b-j}	0.95^{f-r}	25926^{a-c}	7658^{a-g}	R14P3	222.3^{i-x}	17.7^{f-n}	1.00^{b-p}	16296^{m-v}	5871^{f-u}
R5P5	237.3^{a-q}	18.7^{c-l}	1.07^{a-d}	23703^{a-j}	7605^{a-g}	R10P1	214.3^{n-y}	16.0^{i-p}	0.98^{c-r}	20000^{b-u}	5828^{g-u}
R6P4	242.0^{a-m}	18.0^{e-m}	1.06^{a-f}	22593^{a-m}	7437^{a-h}	R8P2	211.0^{p-z}	14.7^{l-q}	0.90^{n-r}	20555^{a-s}	5650^{h-v}
R3P3	255.0^{a-e}	21.7^{a-f}	1.00^{b-p}	23704^{a-j}	7428^{a-h}	R7P5	233.3^{b-r}	20.3^{a-h}	1.03^{a-l}	18704^{f-v}	5638^{h-v}
R4P5	264.0^{a}	20.7^{a-g}	0.99^{b-q}	25185^{a-e}	7306^{a-h}	R9P4	216.0^{l-y}	19.0^{c-k}	0.92^{k-r}	18333^{g-v}	5623^{h-v}
R13P2	226.3^{g-u}	20.0^{b-i}	0.94^{g-r}	24074^{a-i}	7285^{a-i}	R8P4	228.3^{e-t}	16.7^{g-o}	1.02^{b-n}	20741^{a-s}	5589^{h-v}
R2P1	222.7^{i-x}	16.0^{i-p}	0.96^{d-r}	24444^{a-g}	7279^{a-i}	R10P2	214.7^{n-y}	17.3^{g-o}	0.91^{m-r}	19259^{d-u}	5547^{h-w}
R11P3	233.7^{b-r}	20.3^{a-h}	1.00^{b-q}	24815^{a-f}	7258^{a-i}	R9P3	221.7^{j-x}	18.0^{e-m}	0.98^{c-r}	18518^{f-v}	5390^{i-x}
R3P2	250.0^{a-h}	20.3^{a-h}	0.98^{c-r}	24074^{a-i}	7188^{a-j}	R10P3	228.7^{e-t}	17.7^{f-n}	0.94^{f-r}	17963^{h-v}	5340^{j-x}

R3P4	256.7^{a-d}	22.0^{a-e}	0.99^{b-q}	23704^{a-j}	7164^{a-j}	R14P4	213.7^{n-z}	16.7^{g-o}	1.02^{b-n}	15185^{q-v}	5301^{j-x}
R11P2	234.0^{b-r}	16.7^{g-o}	1.01^{b-o}	22963^{a-l}	7114^{a-j}	R16P5	211.3^{p-z}	13.3^{o-q}	0.93^{j-r}	16852^{l-v}	5086^{k-x}
R4P2	253.3^{a-g}	20.0^{b-i}	0.91^{m-r}	24259^{a-h}	7074^{a-j}	R1P5	199.0^{v-a2}	13.7^{n-q}	1.00^{b-q}	18519^{f-v}	4938^{l-x}
R2P4	233.3^{b-r}	18.3^{d-m}	0.97^{c-r}	23704^{a-j}	7051^{a-j}	R7P3	218.3^{k-x}	18.0^{e-m}	0.98^{c-r}	17778^{i-v}	4926^{l-x}
R4P3	259.7^{ab}	24.3^{a}	1.02^{b-m}	22963^{a-l}	6993^{a-k}	R16P3	221.7^{j-x}	16.7^{g-o}	0.92^{l-r}	16111^{n-v}	4895^{l-x}
R14P5	233.0^{b-r}	22.7^{a-c}	1.08^{a-c}	20370^{a-s}	6981^{a-k}	R15P3	213.0^{o-z}	17.3^{g-o}	0.91^{n-r}	16296^{m-v}	4783^{m-x}
R13P1	223.3^{h-x}	18.7^{c-l}	1.10^{ab}	21481^{a-q}	6968^{a-k}	R7P2	216.0^{l-y}	17.0^{g-o}	0.87^{r}	16852^{l-v}	4763^{n-x}
R5P3	221.0^{k-x}	17.3^{g-o}	1.04^{a-k}	21667^{a-p}	6917^{a-k}	R9P2	209.0^{r-z}	17.3^{g-o}	0.95^{f-r}	15741^{o-v}	4754^{n-x}
R5P1	231.7^{c-r}	18.7^{c-l}	1.00^{b-p}	22037^{a-o}	6914^{a-k}	R1P4	202.0^{t-a2}	12.3^{pq}	0.95^{e-r}	17222^{k-v}	4740^{n-x}
R6P1	196.7^{x-a2}	12.3^{pq}	0.91^{n-r}	22963^{a-l}	6761^{a-k}	R16P1	199.7^{u-a2}	16.3^{h-p}	0.89^{p-r}	16296^{m-v}	4699^{o-x}
R5P2	222.7^{i-x}	17.0^{g-o}	0.93^{h-r}	21481^{a-q}	6680^{a-m}	R6P3	222.0^{i-x}	14.7^{l-q}	0.99^{b-q}	19259^{d-u}	4581^{p-x}
R3P1	248.3^{a-j}	19.0^{c-k}	1.02^{b-n}	23518^{a-k}	6621^{a-n}	R15P5	215.0^{m-y}	16.3^{h-p}	0.91^{m-r}	15185^{q-v}	4578^{p-x}
R15P4	232.7^{b-r}	19.0^{c-k}	0.95^{f-r}	21666^{a-p}	6614^{a-o}	R15P1	226.0^{h-v}	17.3^{g-o}	0.93^{h-r}	19630^{c-u}	4493^{q-x}
R12P1	236.7^{b-q}	20.0^{b-i}	1.04^{a-i}	21111^{a-r}	6573^{a-o}	R7P1	211.0^{p-z}	16.0^{i-p}	0.94^{f-r}	15556^{p-v}	4462^{r-x}
R2P5	226.3^{g-u}	17.3^{g-o}	0.99^{b-q}	23889^{a-i}	6564^{a-o}	R15P2	198.0^{w-a2}	$16.^{g-o}$	0.91^{m-r}	13889^{t-v}	4352^{s-x}
R6P5	213.7^{n-z}	14.3^{m-q}	1.04^{a-k}	20000^{b-u}	6542^{a-o}	R9P1	203.3^{s-z}	19.0^{c-k}	0.90^{o-r}	15185^{q-v}	4306^{t-x}
R11P1	228.7^{e-t}	17.0^{g-o}	0.95^{e-r}	22407^{a-n}	6446^{a-p}	R8P1	209.3^{r-z}	13.3^{o-q}	0.97^{c-r}	15926^{o-v}	4216^{u-x}
R2P3	224.7^{h-w}	17.7^{f-n}	0.95^{e-r}	22963^{a-l}	6400^{b-q}	R16P2	189.0^{y-a2}	13.7^{n-q}	0.97^{c-r}	14630^{s-v}	3826^{v-x}
R14P1	225.7^{h-v}	20.0^{b-i}	0.95^{f-r}	18889^{e-v}	6393^{b-q}	R1P1	176.0^{a2}	12.3^{pq}	0.94^{g-r}	12593^{v}	3750^{v-x}
R11P5	218.7^{k-x}	17.0^{g-o}	0.93^{i-r}	21111^{a-r}	6362^{b-r}	R1P2	187.0^{za2}	11.3^{q}	0.98^{c-r}	13704^{uv}	3638^{w-x}
R6P2	228.7^{e-t}	16.7^{g-o}	1.01^{b-o}	20000^{b-u}	6359^{b-r}	R1P3	198.0^{w-a}	11.3^{q}	0.89^{p-r}	14815^{r-v}	3489^{x}
LSD	27.3***	4.3***	0.12**	6452***	1916***	LSD	27.3***	4.3***	0.12**	6452***	1916***
CV	7.5	15	7.3	19.4	19.3	CV	7.5	15	7.3	19.4	19.3

NB. Trt=treatment, *Ph= plant height, Cl cob length, Cpp =cob per plant, Bmy = biomass yield, Gy grain yield. LSD: list significant difference, CV= coefficient of variance.*
Means with the same letters are statistically similar.

Fig. 4 The effect of residual phosphorus on different parameters of maize

Residual	PH	CL	CPP	BMY	GY
R1	192.4^{g}	12.2^{i}	0.95^{d-f}	15370^{e}	4111^{h}
R2	225.4^{cde}	17.3^{fg}	0.96^{c-f}	23926^{a}	6664^{bcd}
R3	252.7^{a}	20.5^{a-c}	0.99^{c-e}	24185^{a}	7212^{ab}
R4	250.9^{a}	21.2^{a}	0.98^{c-e}	23852^{a}	7121^{abc}
R5	230.7^{bcd}	18.3^{d-f}	1.01^{a-c}	22592^{ab}	7164^{abc}
R6	220.6^{de}	15.2^{h}	1^{b-d}	20963^{bc}	6336^{bcd}
R7	223.6^{de}	17.9^{d-f}	0.96^{c-f}	17852^{de}	5159^{fg}
R8	223.1^{de}	15.6^{f-h}	0.97^{c-f}	20926^{bc}	5896^{edf}
R9	215.9^{ef}	18.7^{c-f}	0.94^{ef}	17593^{de}	5258^{fg}
R10	219.9^{de}	16.9^{f-h}	0.92^{f}	19741^{cd}	5713^{efg}
R11	230.5^{bcd}	18.1^{d-f}	0.98^{c-e}	22481^{ab}	6698^{bcd}
R12	242.1^{ab}	19.7^{a-d}	1.05^{a}	24926^{a}	7747^{a}
R13	236.4^{bc}	20.9^{ab}	1.04^{ab}	23556^{ab}	7588^{a}
R14	223.5^{de}	19.2^{b-e}	1.01^{abc}	18074^{de}	6180^{ed}
R15	216.9^{ef}	17.3^{efg}	0.92^{f}	17333^{de}	4964^{g}
R16	206.4^{f}	15.7^{h}	0.93^{f}	16259^{e}	4912^{gh}
LSD	**11.89**	**1.87**	**0.05**	**2719**	831
CV	**7.32**	**14.65**	**7.42**	**18.35**	**18.72**

Ph= plant height, Cl cob length, Cpp =cob per plant, Bmy = biomass yield, Gy grain yield. LSD: list significant difference
Means with the same letters are statistically similar.

Grain yield

Grain yield was significantly affected by different levels of residual Phosphorous. Regardless of the current level of P in the final year the maximum pulled grain yield due to the residual level of P was recorded from R12(with the residual level of 40, 20, 20 and and R13 40, 40, 40 for three years which were 7747 and 7588 kg/ha respectively. The lowest grain yield was recorded from R1 and R16 which were 4111 and 4912 kg/ha. Residual P level of R1 was 0 for four consecutive years where as R16 was the maximum residual which was 80 kg/ha of P for three consecutive years before the main experimental year. This result indicates that the highest accumulation of P in the soil has the same effect as that of no phosphorous in the soil. Masood et.al 2011 also reported that application of excess P above the optimum will result in a reduction of yield and yield related parameters. Similarly they suggested that, optimum rate to cause a desirable increase in production per unit area with per unit increase in P content because the grain yield in the control plots was the lowest whereas it was highest in the plots with P applied at 100 kg ha-1 . Increasing P above 100 kg ha-1 might be excessive that had decreased the grain yield of maize which indicated that applying P in maize above 100 kg ha-1 is uneconomical and just wastage of money. Additionally, other findings also reported that, excess application of phosphorous to agricultural soil might cause it decreases the N:P ratio of water in soil and become toxic to the crops and also soil microfauna which make nutrient availability in the soil (Arbuckle, K. E., & Downing, J. A. (2001).

Biomass Yield

The highest and statistically the same biomass yields were recorded from R2, R3 R4 and R12. The lowest biomasses were recorded from R1 and R16 similar to that of the grain yield.

Maximum number of cobs per plant was also recorded from the same residual R12. The lower number of cob was recorded from R16, R15 and R10. So this result indicates that high accumulation of P in the soil affects the number of cob per each plant. Maximum plant height was recorded from R3 and R4 while the highest cob length was from R4. The lowest result was recorded from R1 and R16.

In all parameters the minimum or lowest data was recorded from the negative control (R1), R16 and R15. The result indicates that lower P was significantly decrease maize yield in all parameters and high accumulation of P in the soil also have the same effect on maize yield. R16 and R15 which are (80, 40, 40 and 80, 80, 80 kg ha^{-1} P respectively) gave very low yield in all parameters. They were the same as the negative control. This indicates high accumulation of P fertilizer in the previous season results significant yield reduction. According to (Forde and Lorenzo, 2001) high accumulation of available P in the soil limits the root density and growth. This intern affects the development of mycorrhizal association which directly affects the uptake of water and micronutrients like Zn and Cu (Mäder et al. 2000 and Williams et al. 2017).

Fig. 5 Effect of different level of P on different parameters of maize

P level	Ph	Cl	Cpp	Bmy	Gy
0	218.5^{b}	17.04^{b}	0.96^{ab}	19688^{c}	5753^{b}
10	219.7^{b}	17.06^{b}	0.95^{b}	20058^{bc}	5903^{b}
20	228.5^{a}	18.21^{a}	0.98^{ab}	20208^{bc}	6041^{b}
30	231.4^{a}	18.54^{a}	0.99^{a}	21296^{ab}	6572^{a}
40	230.4^{a}	18.02^{ab}	0.99^{a}	21759^{a}	6582^{a}
LSD	**6.65**	**1.05**	**0.03**	**1520**	**464**
CV	**7.32**	**14.65**	**7.42**	**18.35**	**18.72**

Mean maximum grain yield 65 ton/ha was recorded from P level of 30 and 40 kg/ha regardless of residual P. Similar result was also recorded from all other parameters but highest plant height and cob length was also recorded from P level of 20 kg/ha. The result indicates that 30 kg of P/ha is the optimum level of P for maximum grain yield of maize. Even though the blanket recommendation of P fertilizer for the area was 20 kg-1 now it is better to revise P recommendation. Site specific fertilizer recommendations are better than blanket recommendation. More application of P has no yield advantage; rather it is an economic ruin.

Interaction effect of residual and P

According to fig. 3, the highest grain yield 8359 kg/ha was recorded from the interaction R12P3 which means a residual of 0, 40, 20, 20 kg P/ha for four consecutive years and 20 kg/ha at the experimental year. This indicates that 20 kg P in the form of TSP is better level of P fertilizer for residual effect and for the experimental year after once application of 40 kg. This result matches to the previous researches of fertilizer rates of maize which was 20 kg ha^{-1} or 100 kg TSP (Masood et.al 2011). The lower grain yield was recorded from treatments 0 residual P with 0, 10, and 20 level of P kg/ha. At R16, R15, R9 and R8 with different level of P were also recorded lower maize grain yield.

4. Conclusion

High accumulation of residual phosphorus results a significant yield reduction of maize grain yield. Lower P level and high accumulation results the same yield loss of maize grain and biomass. The interaction effect of residual and current level of phosphorus gives better result at 40,20,20 residual and 20 kg ha^{-1} the current level of P. the research result indicates that continuous application of phosphate fertilizers releases available P in the soil and it's accumulation will negatively affects crop yield. There for the authors suggested that it is better to optimize the residual level of phosphorus fertilizer and the current year dosage for the better grain yield of maize.

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