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DETERMINIG THE RATE OF PHOSPHORUS ASSIMILATION BETWEEN FOLIAR AND SIDE DRESSING METHODS OF APPLICATION IN BRASSICA RAPA

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Abstract*-A reduction in the production of vegetables especially in Brassica rapa has mainly been as a result of the underutilization of the applied fertilizers which in most instances is lost through leaching and or by forming complexes in the soil when the fertilizer is applied through placement or side dressing. It was also observed that, the fertilizer applied through foliar method of application under heavy downfall of rainfall makes the fertilizer unavailable as it is washed away. Because of the raised concerns and reasons attributing to the loss of this essential needed element to the plants in particular to Brassica rapa for growth and development it is therefore imperative to ascertain the rate of fertilizer assimilation in the this economically grown vegetable and come up with a more economical and effective means of supplying fertilizers to the plant in order to promote full utilization of the applied fertilizer and at the same time reduce the loss of the applied fertilizer and promote good yields in Brassica rapa. A research was carried out in Lusaka's Mtendere area (Golf Side Area) for a period of three months, from February to May 2019 to determine the rate of phosphorus assimilation in Brassica rapa using two different methods of fertilizer application namely side dressing application of phosphorus and foliar application of phosphorus fertilizers. From the results obtained from the three treatments on the amount of phosphorus content in plants, from the control treatment the amount of phosphorus content was lower compared to the other two treatments which were supplied with phosphorus fertilizer with the second treatment supplied with phosphorus through side dressing and the third treatment supplied with phosphorus fertilizer through foliar method. Plants that had a supplementation of phosphorus fertilizer through foliar method recorded a high amount of phosphorus assimilated with the method of application representing 83.1% of the total phosphorus assimilated in Brassica rapa while side dressing method of phosphorus application represented 72% of phosphorus assimilated. It was therefore concluded that foliar method of applying phosphorus fertilizer was ideal compared to side dressing method of phosphorus fertilizer application in Brassica rapa as it showed a high degree of utilizing phosphorus and this was as a result of the quick assimilation phosphorus in plants that were supplied with phosphorus through foliar.* ***Key words: Brassica rapa, Assimilation rate, Phosphorus, Foliar fertilizer and Granulated fertilizer***

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Introduction

Increased crop production largely depends on the type of fertilizers used to supplement essential nutrients for plants. Fertilizer application is required to replace crop land nutrients that have been consumed by previous plant growth with the ultimate goal of maximizing productivity and economic returns and to achieve this an effective and economic method of fertilization must be used which will promote quick uptake and maximum utilization of the applied fertilizer.

Growing agricultural crops implies that nutrients (N, P, and K) are removed from the soil through the agricultural produce (food, fibre, wood) and crop residues. Nutrient removal may result in a decline of the soil fertility if replenishment with inorganic or organic nutrient inputs is inadequate. Soil fertility is defined as ''the quality of a soil that enables it to provide nutrients in adequate amounts and in proper balance for the growth of specified plants or crops [5].

Further observation by foliar fertilization is now being widely used to correct nutritional deficiencies in plants caused by improper supply of nutrients to roots [5]. Most of the important agricultural soils in Zambia suffer from severe Phosphorus deficiency. This is attributed to the high soil pH due to the presence of calcium carbonate. Under such conditions, the utilization by plants of fertilizer Phosphorus is generally very low due to sorption of Phosphorus by soils. [5] It is important to note that Phosphorus occurs in many forms and this depends largely on factors including pH and chemical composition of the soil. In a particular growing season only a portion of the total soil Phosphorus is available to the crop, however the supply of available Phosphorus is constantly replenished from reserves of less available Phosphorus in the soil. It is also important to note that the source of phosphorus which is available to the cultivated crop may come from this year's fertilizer application, residual fertilizer, or from the mineralization of organic residues. Roots play an important role in the absorption of phosphate ions and this happens only when they are dissolved in the soil water [8]. Phosphorus deficiencies can occur even in soils with abundant available P under the following conditions such as drought, low temperatures, or disease interfere with Phosphorus diffusion to the root through the soil solution or otherwise stunt normal root development and function [4]. Proper irrigation management and scheduling is critical for plant development and utilization of applied nutrients. Vegetable plants require an adequate supply of Phosphorus throughout the growing season to achieve optimum quality and yield. During the early growth stages, Phosphorus stimulates the development of a vigorous root system and healthy tops. Plant demand for Phosphorus peaks during the early stages of development, and then slows during later at maturation [3].

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Distinct Phosphorus deficiency symptoms are usually visible in vegetables, deficiencies of Phosphorus can strongly affect overall growth rates that foliar symptoms are not very dramatic when compared to those seen with Nitrogen or Potassium. Only when Phosphorus is very low or and other nutrients are well supplied are symptoms distinctive. Plants will appear stunted and abnormally dark green in color. In severe cases, especially in cool soils, the foliage, stems or stalk may exhibit reddish-purple pigment. Phosphorus translocates from older tissue to new, actively growing tissue quite readily, so discoloration tends to appear on older tissue first. Phosphorus deficiency is often difficult to diagnose correctly from visual symptoms alone. Soil and plant tissue analyses are required to confirm this deficiency.

[4] Phosphorus plays an essential role in plant health and root development, which directly impacts yield and quality. The Phosphorus requirement of vegetables is frequently higher than the Phosphorus required for many field crops due to the high nutrient demand of vegetables and their relatively shallow root system. Therefore, some fertilizer Phosphorus is commonly recommended for vegetables grown in a crop rotation. The need for Phosphorus fertilization should be established by a soil sample taken prior to planting. Since Phosphorus generally moves very little in soil, it is important to place the Phosphorus within the root zone to stimulate the early-season growth required for high yields [4]. Pre-plant Phosphorus applications (broadcast or banded) are generally preferred, however foliar method of phosphorus application are now being widely used and but mid-season applications may be useful when needed. When petiole analysis indicates a risk of Phosphorus deficiency, a soluble Phosphorus fertilizer (typically 10-34-0) may be applied through an irrigation system to provide a mid- or late-season boost. This Phosphorus fertigation technique is beneficial only if adequate roots are present near the soil surface, as frequently occurs after the canopy shades the hill during mid-season.

[4] Commonly available Phosphorus fertilizer sources are equally useful for *brassica rapa* nutrition. The selection of a particular Phosphorus fertilizer is generally based on grower preference, price, and compatibility with application equipment. Recent research suggests that modifications to Phosphorus fertilizer, such as polymer additives, humic substances and coatings may be beneficial in improving Phosphorus uptake and production.

PROBLEM STATEMENT

Despite the use of the various inorganic fertilizers, there has been underutilization of fertilizers in plants due to the slow rate of assimilation resulting in low yields hence it is imperative that the farmers understand the most economical and effective method of fertilizer

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application which reduces wastage of fertilizer but at the same time promoting the highest degree of fertilizer utilization within the shortest time possible.

This problem can be attributed to the lack of information on the part of the farmers on the correct methods of fertilizer application to be used which promotes quick assimilation and maximum utilization of the supplied fertilizer to the vegetables.

Another reason that can attributed to this challenge is the lack of research on the part of agriculture specialists to find ideal methods of fertilizer application and communicate the research findings to the farmers and the government department responsible for fertilizer management and bring about policy formulation in the management of fertilizers.

1.3 Justification of this research

The research was undertaken to find ideal means of phosphorus fertilizer application in *Brassica rapa* that promotes quick assimilation of phosphorus which is an essential mineral element and subsequently form a basis for advising the government and eventually use the findings to influence legislation in the field of fertilizer use and plant nutrition.

Furthermore, this research also seeks to address some major issues related to the agronomic management of plant nutrients in an attempt to ensure both enhanced and sustainable agricultural production and to safeguard the environment.

This research is also intended to promote the assessment of plant nutrient uptake *Brassica rapa* in relation to the method of fertilizer application and the influence on the method of application with the soil pH on a farming system basis and monitoring of soil fertility. It will help in the formulation of advice to governments and eventually legislation in the field of fertilizer use and plant nutrition.

1.4 Main objective

Determining the rate of phosphorus assimilation between foliar and side dressing methods of application in brassica rapa.

1.5 Specific objectives

1 To determine an ideal way of fertilizer application that promotes quick assimilation of phosphorus.

2. To determine the extent to which the method of phosphorus fertilizer application influences the soil ph.

3. To determine the method of phosphorus fertilizer application that has the minimum rate of assimilation.

1.6 Research questions

1. Does the method of phosphorus application influence the rate of assimilation?

2. Does the type of fertilizer application have an influence on soil pH?

3. Do the two methods have the same rate of assimilating phosphorus?

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1.7 Hypothesis

1: Null hypothesis: there is a difference in the rate of assimilation between foliar application of phosphorus and side dressing method of phosphorus

Alternative hypothesis: there is no difference in the rate of assimilation

2: There is great correlation on soil pH status with the type fertilizer application method.

Alternative: there is no correlation.

MATERIALS AND METHODS

The research was carried out in Mtendere's golf side area in Lusaka, Zambia. *Brassica rapa* was grown in polythene plastics to avoid interference of phosphorus. The experiment had 3 treatments in which the first treatment was a control and hence there was no fertilizer added, the second treatment was supplied with solid phosphorus fertilizer through side dressing and the third treatment was supplied with phosphorus fertilizer through foliar method of application. Prior to planting the determination of pH was carried out and the results were as follows for the three treatments. At the of the research another analysis on the pH of the soil was carried and this was done in order so determine the influence of the type of fertilizer application method on pH and at the same to determine the extent to which each type of fertilizer application method influences the soil ph.

After two weeks of germination, tissue samples of *Brassica rapa* were collected and in each plastic polythene bag there were two plants of *Brassica rapa* from which the stems of brassica were used to obtain the tissue samples. The plant tissue samples were dried in a hot air oven and late taken in the muffle furnace for ashing. Ashing is a process of heating the plant samples to remain with a byproduct in the form of ash which is used for testing the mineral content and in this research ashing was used for testing tissue phosphorus levels. Collection of the plant tissue samples for tissue analysis was done every after two weeks at three intervals in the entire research. Below is the map of Mtendere (research site and the surrounding areas).

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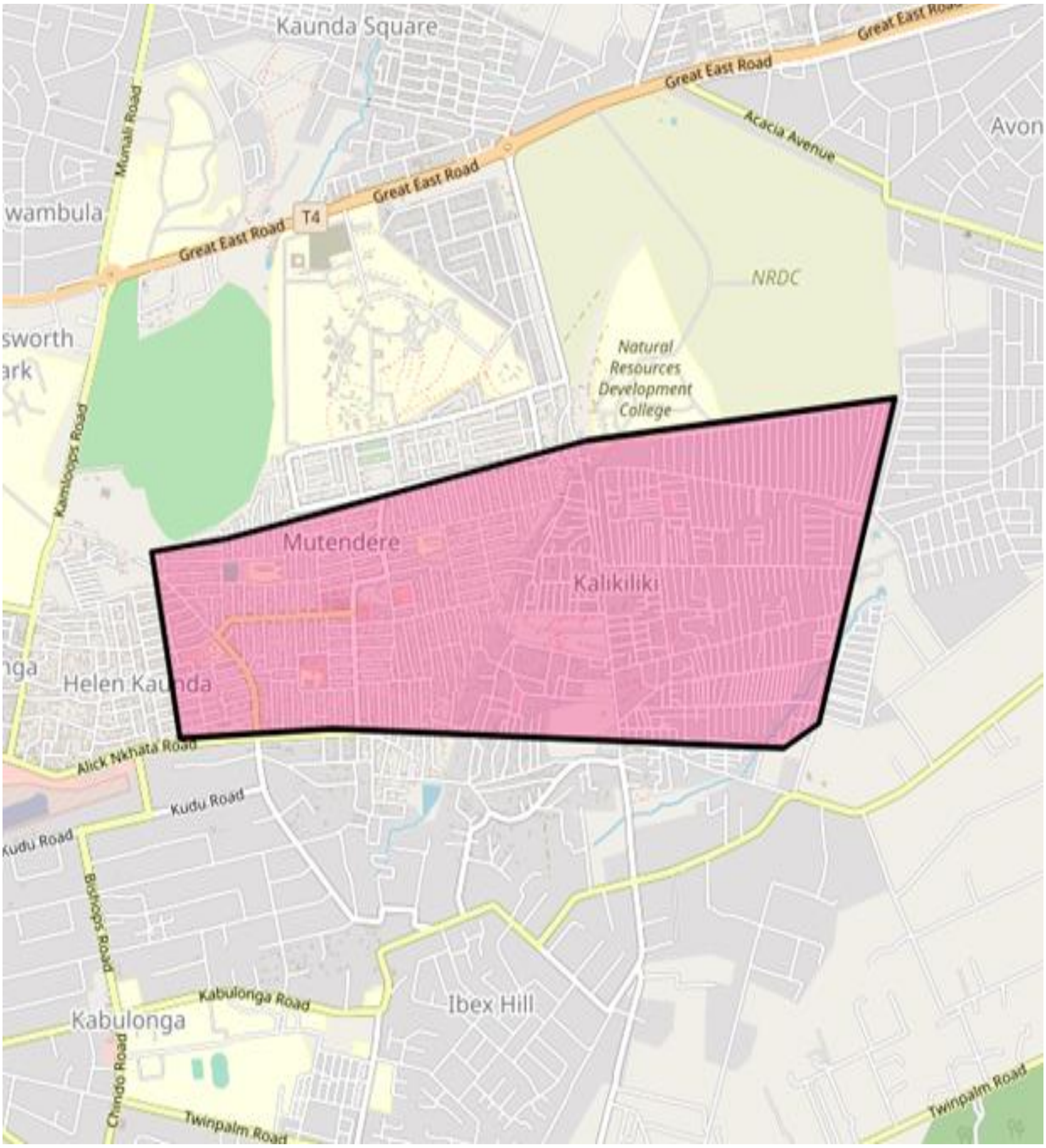
Figure 1: Research site



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Plant tissue tests

The first collection of the plant tissue samples was at week 4, the second collection was at week 6 and third

collection of the samples for tissue analysis was at week 8. Bray one method of extracting phosphorus was used as it is the standard method used in Zambia because of the soils being generally acidic across the country. Standard stock solution

First a standard stock solution was made which was of high concentration, 1000ppm Phosphorus from where dilutions for working standards were to be made. It was made by dissolving 4.3963g of reagent grade Potassium di-hydrogen phosphate (KH_2PO_4), which has been oven dried in deionized water. Then

The standard stock solution was stored in a cool dark place as it was to be used in the entire research and this was done so to avoid green a

How reagents a and b were prepared

The determination of phosphorus using the Bray 1 method involves the preparation of various stock solutions, therefore in this research, the researcher in making the stock solutions also known as reagent A and reagent B, Ammonium fluoride solution, (NH_4F) 1molar was dissolved in 18.50g of ammonium fluoride AR grade in distilled water to make up to 500ml. Thereafter hydrochloric acid (HCl) 1molar was diluted into 44.5ml of concentrated hydrochloric acid to 500ml with distilled water. The extracting solution was then mixed together with 30mls of ammonium fluoride solution and 25mls hydrochloric acid and made up to the mark with distilled water in a 1litre. Then in the final stage of making reagent A, 12.09g of ammonium molybdate was dissolved in a 250ml with distilled water warm on a hot plate until completely dissolved. Then dissolve 0.2908g of Antimony potassium tartrate in 100mls of distilled water. Finally mix everything in a 2 litre volumetric flask add 140mls of concentrated sulphuric acid and fill to the mark with distilled water shake well and store in cool dry place. To develop color for the standard concentration 1.056g powder of ascorbic acid was dissolved in a 200ml of reagent A and mixed.

Working standards preparation and calibration

From a stock solution of 1000 ppm Phosphorus a solution of 1ppm Phosphorus was prepared in a litre. From the 1 ppm Phosphorus solution, working standards were prepared with the concentrations of 0 ppm, 0.1 ppm, 0.2 ppm and 0.4 ppm Phosphorus solutions by pipetting 0mls, 5mls, 10mls and 20mls into a series of four micro-beakers respectively. After that I added 40mls, 35mls, 30mls and 20mls of distilled water respectively and added 10mls ascorbic acid to all of them and waited for 20 minutes for the color to fully develop.

The UV-spectrophotometer was then switched on and allowed to warm for 15 minutes before it was use and the instrument was set at 100%

transmittance and 0 absorbance and then calibrated the instrument by insetting the prepared working standards 0ppm, 0.1ppm, 0.2ppm and 0.4ppm Pas 0.0ppm, 10ppm, 20ppm and 40ppm of P respectively and, read and recorded their absorbance and the graph below is plotted for their absorbance. The Plotted graph of absorbance, on the Y-axis, against concentration, on the X-axis.

Standard stock solution

First a standard stock solution was made which was of high concentration, 1000ppm Phosphorus from where dilutions for working standards were to be made. It was made by dissolving 4.3963g of reagent grade Potassium di-hydrogen phosphate (KH_2PO_4), which has been oven dried in deionized water. Then

The standard stock solution was stored in a cool dark place as it was to be used in the entire research and this was done so to avoid green algae from growing in the solution as it would start thriving on phosphorus from the solution thereby reducing its concentration in the solution.

How reagents a and b were prepared

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The UV-spectrophotometer was then switched on and allowed to warm for 15 minutes before it was use and the instrument was set at 100% transmittance and 0 absorbance and then calibrated the instrument by insetting the prepared working standards 0ppm, 0.1ppm, 0.2ppm and 0.4ppm Pas 0.0ppm, 10ppm, 20ppm and 40ppm of P respectively and, read and recorded their absorbance and the graph below is plotted for their absorbance. The Plotted graph of absorbance, on the Y-axis, against concentration, on the X-axis.

Reagents used in making stock solutions used testing soil P content

Reagents that were used in making reagent stock solutions used in the research included ascorbic acid and standard stock solution which had a concentration of (100ppm P) in order to produce the color indicator as the determination of phosphorus using spectrophometry measures the absorbance from the color indicator. For the determination of the soil phosphorus level, 2.5 g of soil was weighed and placed in a polyethylene extraction beaker. 25 mL of extracting solution was added using a dispenser and put on a shaker for 1 minutes at 180 oscillations per minute.

Filtration

Filtering was done into the receiving beaker and then Re-filtered again get a clear solution.

Color Development

As stated earlier that the determination of P using Bray 1 method involves measuring the absorbance from the color against the concentration and therefore the researcher developing the color he pipettes 5mls of the sample into a 50ml macro beaker and added 10mls ascorbic acid.

Determination of phosphorus content in plant tissue samples

Determining P content levels in a plant or from plant tissues is slightly different from the way P in soils is being determined. Dry ashing was used for the plant tissue samples in determining the amount of phosphorus content. The researcher weighed an amount 2.0g of plant material is placed it into a crucible and digested (ashed) by heating it in a muffle furnace for six hours. The ash residue was then dissolved in an acid solution, which was then filtered and diluted. The temperature used for ashing was 600 °C and then the same procedure that was in determining soil phosphorus was used.

Determination of soil pH

In this research, it was imperative for the researcher to determine the PH levels in the soil prior to planting as the results which were obtained were used determining the influence of the type of fertilizer to the soils PH after cultivation.

Procedure

The researcher weighed 30grams of air dry soil which was then put into 100ml beaker thereafter added 60ml of $CaCl_2$ solution into the beaker. Thereafter soils were allowed to absorb the suspension medium for three hours and were then later stirred thoroughly for 10 seconds using a glass electrode. The soil samples were left overnight for homogenization. The next day the samples were stirred again before reading them. The samples were read after homogenization by first calibrating the pH meter with the buffer solutions (pH4 and pH7) and the PH results were recorded.

	IPPM	IPPM	IPPM	FPPM	FPPM	FPPM
TREATS	T 1	T2	T3	T1	T2	T3
WEEK4	0.61	0.88	0.89	0.09	0.13	0
WEEK6	0.52	0.75	0.89	0.19	0.24	0
WEEK8	0.33	0.51	0.49	0.24	0.31	0

DATA COLLECTION

In accordance with the laid down procedures in the lab manual used at Zambia Agriculture Research Institute (ZARI), data was recorded every after two weeks for three consecutive times in the research process and the following results were recorded as shown in the table below on the initials of soil phosphorus (ippm) as well as the amounts of tissue phosphorus in plant samples (fppm).

Raw data collected

Equations and calculations used to find the rate of phosphorus assimilation as well as the total phosphorus assimilated in the first treatment (treatment 1/ control).

The reading on the auto-absorption spectrophotometer on the initial phosphorus content in the soil was 0.61ppm per 5000grams of the soil sample which was contained in the plastic polythene bag.

After conducting a tissue analysis on the amount of phosphorus content in the plant sample the results were obtained on the auto-absorption spectrophotometer with a reading of 0.09ppm. This being the first reading of week4 in the intervals of tissues analysis, it was therefore taken as the initial amount of phosphorus assimilated in the plant, it being the first reading. For the next interval of plant tissue analysis which was carried after 14 days of the first tissue analysis, the following equation was used to find the rate of phosphorus assimilated in the same treatment (treatment 1/ control)

$$FPPM(WEEK\ 6) - FPPM(WEEK\ 4) = Rate\ of\ P\ assimilation\ /ppm$$

Were FPPM (week 6) is the amount of phosphorus assimilated after 6 weeks of germination and the FPPM (week 4) is the amount of phosphorus assimilated after 4 weeks of germination.

$$FPPM(WEEK\ 6) - FPPM(WEEK\ 4) = Rate\ of\ P\ assimilation\ /ppm$$

$$0.19ppm - 0.99ppm = 0.1ppm$$

Therefore, the rate of phosphorus assimilation between week 4 and week 6 was at 0.1ppm.

To find the rate of phosphorus assimilation between week 6 and week 8 the following equation was used.

$$FPPM(WEEK\ 8) - FPPM(WEEK\ 6) = Rate\ of\ P\ assimilation\ /ppm$$

$$0.24ppm - 0.19ppm = 0.05ppm$$

Therefore, the rate of assimilation was at 0.05ppm

To find the total amount of phosphorus assimilated the following equation was used which is also in the lab manual for soil chemistry at ZARI

$$\sum(Rates\ of\ assimilation\ at\ all\ intervals)$$

$$\sum(0.09 + 0.19 + 0.24 = 0.52ppm)$$

Therefore, the total amount of phosphorus assimilated in the first treatment (control) was 0.52ppm of phosphorus.

Equations and calculations used to find the rate of phosphorus assimilation as well as the total phosphorus assimilated in the first treatment (treatment 2/ side dressing).

The second treatment (side dressing) method of phosphorus fertilizer amendment was used, the initial phosphorus content in second treatment was the combined amount of phosphorus in the fertilizer and that which was in the soil. This was because of the addition of the phosphorus fertilizer and the reading on the auto-absorption spectrophotometer on the initial phosphorus content was 0.88ppm. After conducting a tissue analysis on the amount of phosphorus content in the plant sample the results were obtained on the auto-absorption spectrophotometer with a reading of 0.13ppm as the *fppm* in the plant samples. This being the first reading of week4 in the intervals of tissues analysis, it was taken as the initial amount of phosphorus assimilated in the plant.

For the next interval of plant tissue analysis which was carried after 14 days of the first tissue analysis, the following equation was used to find the rate of phosphorus assimilated in the same treatment (treatment 2/ side dressing)

$$FPPM(WEEK\ 6) - FPPM(WEEK\ 4) = Rate\ of\ P\ assimilation\ /ppm$$

$$0.24ppm - 0.13ppm = 0.11ppm$$

Therefore, the rate of assimilation was at 0.11 between week 4 and week 6 in treatment two in which phosphorus fertilizer was applied through side dressing.

To find the rate of phosphorus assimilation between week 6 and week 8 the following equation was used.

$$FPPM(WEEK\ 8) - FPPM(WEEK\ 6) = Rate\ of\ P\ assimilation\ /ppm$$

$$0.31ppm - 0.24ppm = 0.07ppm$$

To find the total amount of phosphorus assimilated the following equation was used

$$\sum(Rates\ of\ assimilation\ at\ all\ intervals)$$

$$\sum(0.13 + 0.24 + 0.31 = 0.68ppm)$$

Therefore, the total amount of phosphorus assimilated in the second treatment (side dressing) was 0.68ppm of phosphorus.

Equations and calculations used to find the rate of phosphorus assimilation as well as the total phosphorus assimilated in the third treatment (foliar fertilizer).

The third treatment was supplied with phosphorus fertilizer also though through foliar method of application. The third treatment (foliar) method of phosphorus fertilizer amendment was used, the initial phosphorus content in third treatment was the combined amount of phosphorus in the fertilizer and that which was in the soil. This was because of the addition of the phosphorus fertilizer and the reading on the auto-absorption spectrophotometer on the initial phosphorus content after adding the fertilizer was 0.89ppm. After conducting a tissue analysis on the amount of phosphorus content in the plant sample the results were obtained on the auto-absorption spectrophotometer with a reading of 0.31ppm as the *fppm* in the plant samples. This being the first reading of week4 in the intervals of tissues analysis, it was taken as the initial amount of phosphorus assimilated in the plant.

For the next interval of plant tissue analysis which was carried after 14 days of the first tissue analysis, the following equation was used to find the rate of phosphorus assimilated in the same treatment (treatment 3/foliar)

$$FPPM(WEEK\ 6) - FPPM(WEEK\ 4) = Rate\ of\ P\ assimilation\ /ppm$$

$$0.26ppm - 0.14ppm = 0.12ppm$$

Therefore, rate of assimilation was 0.12 between week 4 and week 6 of the third treatment.

To find the rate of phosphorus assimilation between week 6 and week 8 the following equation was used.

$$FPPM(WEEK\ 8) - FPPM(WEEK\ 6) = Rate\ of\ P\ assimilation\ /ppm$$

$$0.34ppm - 0.26ppm = 0.08ppm$$

Therefore, the rate of assimilation between week 6 and week 8 was 0.08ppm

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To find the total amount of phosphorus assimilated the following equation was used

$$\sum(Rates\ of\ assimilation\ at\ all\ intervals)$$

$$\sum(0.14 + 0.26 + 0.34 = 0.74ppm)$$

Below is a summarized table for the above calculations used to find the rate of assimilation per week and total p assimilated

Amount of tissue phosphorus obtained in the week 6- Amount of phosphorus recorded in the plant tissue in week 4. And similarly the amount subtracting the amount of tissue phosphorus recorded in week6 from the amount of tissue phosphorus recorded in week 8 which then gave us the rates of phosphorus uptake per week.

Table: 1

Showing the rate of assimilation every after two weeks

Treatments	Control	side dressing	foliar application
Rate Of Assimilation In The First Interval	0.09ppm	0.13ppm	0.14ppm
Rate Of Assimilation In The Second Interval	0.1ppm	0.11ppm	0.12ppm
Rate Of Assimilation In The Third Interval	0.05ppm	0.07ppm	0.08ppm

Table: 2

I. SHOWING THE COMPUTATIONS ON THE RATE OF ASSIMILATION

WEEKS	CONTROL	SIDE DRESSING	FOLIAR
WEEK 4	0.09PPM	0.13PPM	0.14 PPM
WEEK 6	0.19-0.09=0.1PPM	0.24-0.13=0.11PPM	0.26-0.14=0.12PPM
WEEK8	0.24-0.19=0.05PPM	0.31-0.24=0.07PPM	0.34-0.26=0.08PPM
TOTAL PASSIMILATED	0.24PPM	0.31PPM	0.34PPM

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Table: 3

Showing the differences among the treatment groups

(I) groups		n Difference (I-J)	Error	Sig.	95% Confidence Interval	
					er Bound	Upper Bound
Control	side dressing	-.023333	0460	.837	.14748	.10081
	Foliar	-.093333	0460	.131	.21748	.03081
le dressing	control	.023333	0460	.837	.10081	.14748
	foliar	-.070000	0460	.270	.19414	.05414
Foliar	control	.093333	0460	.131	.03081	.21748
	side dressing	.070000	0460	.270	.05414	.19414

Table: 4

groups	N	Subset for alpha = 0.05
		1
Control	3	.08000
side dressing	3	.10333
foliar	3	.17333
Sig.		.131

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Table 5

Summary table on the minimum and maximum rate of phosphorus assimilation

.	summariz	art2 art3				
	Variable	Obs	Mean	Std. Dev.	Min	Max
	art1	3	0.08	0.026458	0.05	0.1
	art2	3	0.103333	0.030551	0.07	0.13
	art3	3	0.113333	0.030551	0.08	0.14

Table: 6

Soil pH values before planting

treatments	Treatment 1(control)	Treatment 2 (side dressing)	Treatment 3 (foliar)
Ph values	5.2	4.8	5.1

Table: 7 Soil pH values after cultivation

treatments	Treatment 1(control)	Treatment 2 (side dressing)	Treatment 3 (foliar)
pH values	5.4	5.6	5.3

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Table: 8

Results for Pearson correlation on pH and the type of fertilizer application method

Correlations

		soil pH values before planting	soil pH values after cultivation
Soil pH values before planting	Pearson Correlation	1	-.839
	Sig. (2-tailed)		.367
Soil pH values after cultivation	Pearson Correlation	-.839	1
	Sig. (2-tailed)	.367	

Figure: 2

SCATTER PLOT SHOWIN THE CORRELATION ON SOIL PH WITH THE TYPE FERTILIZER APPLICATION METHOD

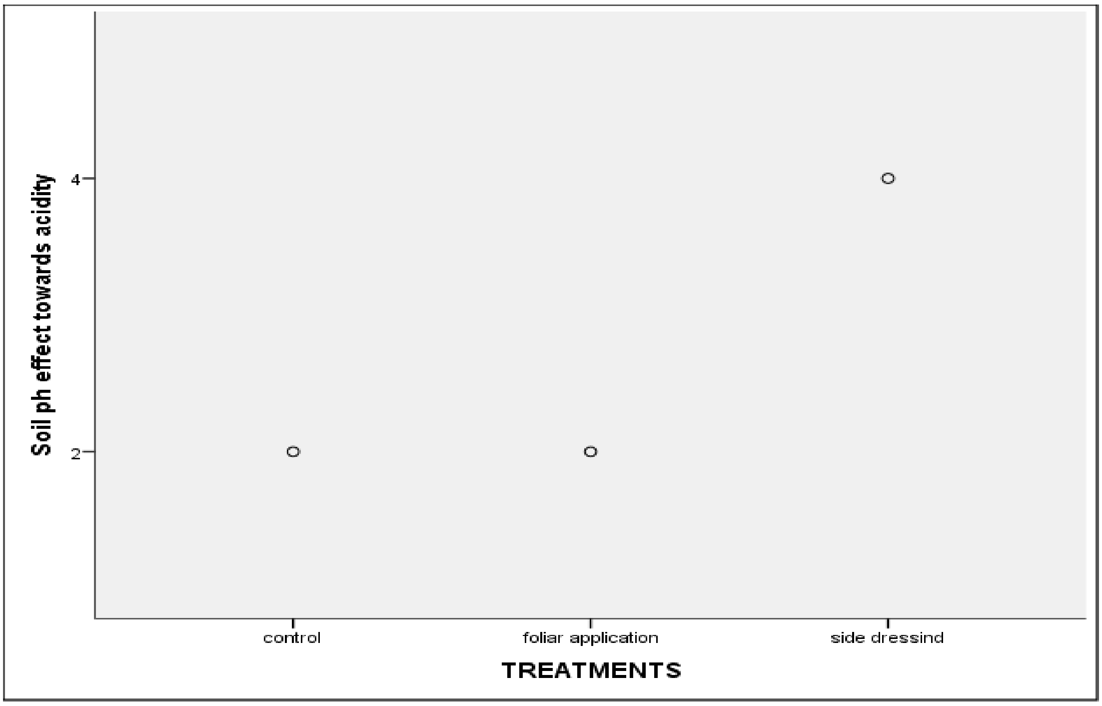

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Figure 3

Showing the amount of total phosphorus assimilated in the three treatments

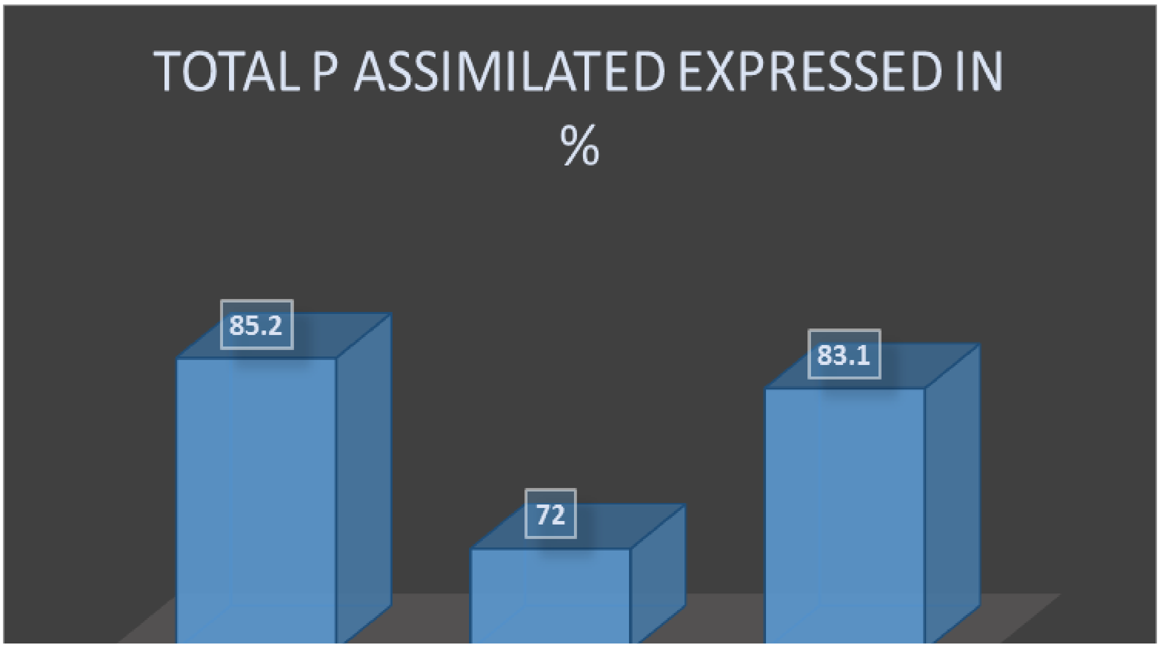

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Figure 4

Showing amounts of phosphorus assimilated at intervals every after two weeks

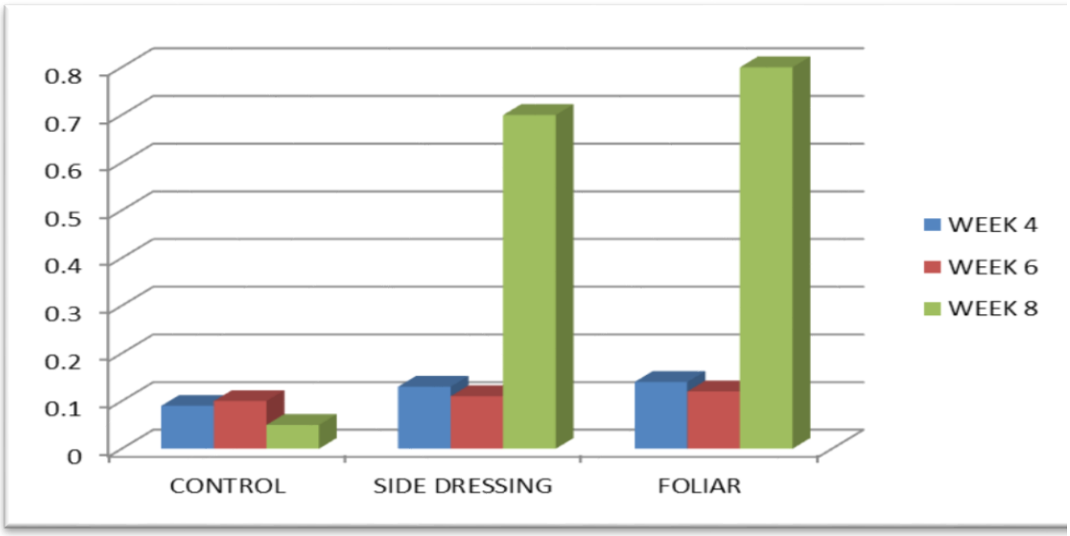
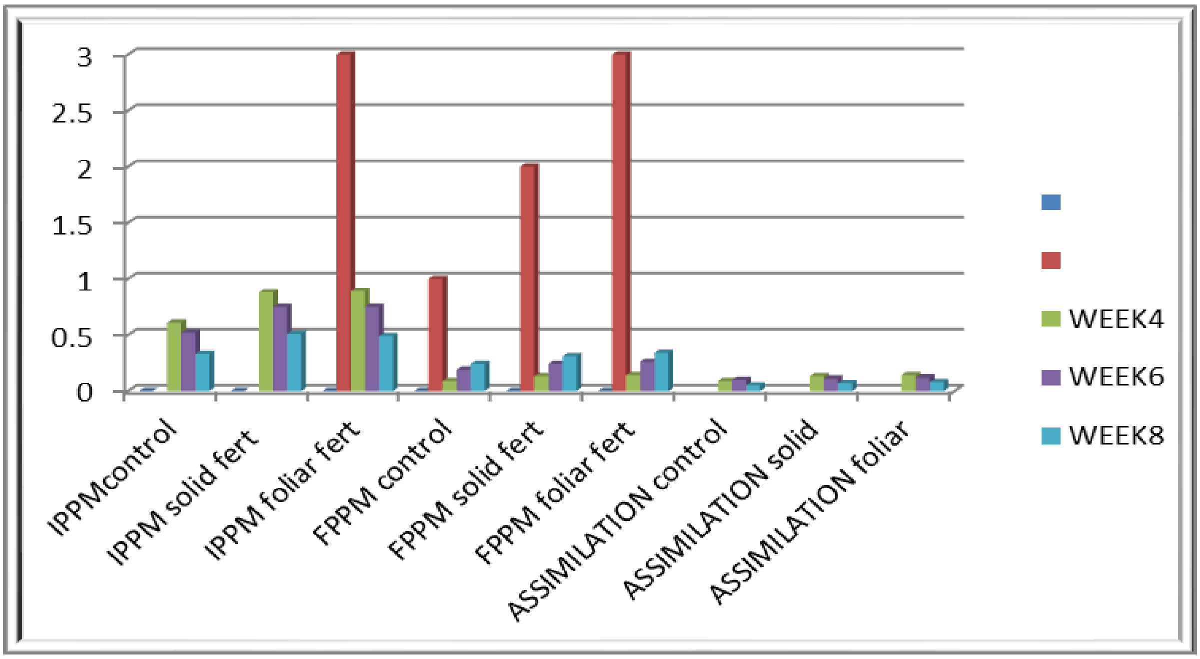


Figure: 5

DISCUSSION OF RESULTS

Showing the initials of phosphorus content in the three treatments as well as the final levels of tissue phosphorus content in plants



The results obtained after performing a one way anova analysis in SPSS, the significance was found to be 1.33 which is greater than the 0.05 test level of significance therefore I reject the alternative hypothesis. These results are similar with the results obtained in a research that was done by (Ling F, 2007) in his research of determining the response of maize to foliar with soil application of nitrogen, phosphorus and potassium fertilizers.

Hypothesis

There is great correlation on soil pH with the type fertilizer application method.

Notes on the claim

The correlation between the type of fertilizer and the soil pH was quite strong however not very significant because the statistical P value (0.367) was less than 0.5 and as such I therefore reject the alternative.

According to (Piri. I, 2012) in a similar research that was carried in Pakistan in determining the rate of Phosphorus assimilation in sorghum using two different methods of phosphorus application namely, foliar application and side dressing through his statistical analysis of variance he observed that foliar method of phosphorus application promoted quick assimilation of P compared to side dressing which agrees with the findings I recorded that which show foliar method of P application to promote quick assimilation compared to side dressing as proven statistically on chart 2 and figure 8. Furthermore (Piri. I, 2012) also recorded that grain yield was high in the plot that was supplied with P through foliar application compared to the sorghum plants that were supplied with P through side dressing. According to the results of (Chakwizira .E and Moot D.J 2009) on the mean comparison gave the highest yield from the plot that was supplied with foliar P method of application and the lowest yield was observed from the plots that were supplied with P through side dressing which is similar to the findings of (Piri. I, 2012). However, yield was almost the same from my research across the treatments as that can be attributed to small difference in the amount of P assimilation across the three treatments and that can be seen from figure 11 on the mean differences among the treatments which have an effect on yield. Between fertilizer treatments there was significant difference on the Grain yield. Foliar application of phosphorus increased grain yield and at the same time foliar method of Phosphorus fertilizer application had significant effect on the harvest index. What was also observed from the mean comparisons was that grain yield was still high in plots supplied with P through foliar even by reducing the percentage of phosphorus concentration in liquid P by 2%. These results are also similar to the findings in a research that was done by (Aslam khan, 2005) in Pakistan in determining a high yielding method of applying phosphorus in *Brassica napus* through foliar and placement. Similarly, to the results I recorded plot three which was supplied with foliar fertilizer showed a slight increase in the rate of phosphorus assimilation compared to plot two which was applied with solid fertilizer through side dressing. However, the difference in terms of phosphorus assimilation between foliar and side dressing method was very small with a mean difference 0.07 using the Turkeys HSD analysis in SPSS. Furthermore, there was a mean difference of 0.09 in terms of phosphorus assimilation between foliar and the control treatment as shown from statistical computations on figure 11. In my research from the observed results plot three also had assimilated slight high amount of the total amount of phosphorus absorbed compared to treatment two in which solid fertilizer was applied through side dressing and these results are also similar to the findings recorded by (Chakwizira.E and Moot.D.J, 2009) in a research to determine the effect, rate and method of phosphorus application on the growth of pasja crops in Malawi. Plot three not only did it record an increase in the rate of phosphorus assimilation compared to plot two it also absorbed the most of phosphorus in the comparative experiment and these results are similar to the results observed by (Chakwizira.E and Moot. D. J,2009).

CONCLUSION

The challenges being faced by most farmers in terms of poor yields in the production of vegetables to be particular in *Brassica rapa* as well as the wastage of fertilizers through forming compounds can be addressed by using spray foliar methods of fertilizer. Not only is the fertilizer lost when applied in soil with poor environmental conditions the fertilizer might also cause pollution to the environment when applied in excess amounts. There sprays foliar fertilizer for applying P not only is it environmentally friendly compared to side dressing or placement it also promotes quicker rate of assimilating the supplied P compared to the treatment in which P was supplied through side dressing. Furthermore, the treatment in which P was supplied through foliar recorded high efficiency in total P absorbed compared to treatment supplied with P through side dressing.

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