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Plant Tissue Nutrient Concentration and Major Soil Nutrients Influenced by NPSB Fertilizer Rates and Plant Population of Maize (Zea Mays L.) at Bako, Oromia National Regional State

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Abstract
Plant nutrients such as nitrogen, phosphorus, potassium and sulfur are the nutrients frequently limit the yields of maize over the world. Nutrient recommendation should be based on the optimum yield and environmental save that can be through plant tissue analysis and soil test. This experiment was conducted at Bako Agricultural Research Center west region of Ethiopia Gobu Sayo using split plot desighn with three levels of plant population 53.333,66,666 and 76,923 plants per hectare on main plot and five level 0,100,150,200,250 kg/ha of NPSB fertilizer rates on sub-plots. Soil sample was taken from the plots pre-harvesting for composite sample and post-harvest from each plot and analyzed at Bako soil laboratory and Ethiopia water work design Addis Ababa for soil fertility management. Nutrient in plant tissue was analyzed at Holota Agricultural Research Center soil laboratory. Collected data was analyzed using Genstat computer statistical soft-ware package. The result of pre planting soil analysis showed soil of the study area was categorized as clay soil with medium and stable organic matter and low organic carbon and low total nitrogen that shows low soil fertility. The ANOVA result showed addition of fertilizer reduced soil pH from 5.7 to 5.47 and bellow. 150 kg/ha of NPSB which gave economically feasible yield 9460kg/ha moderately acidified the soil. This soil analysis result showed that the level at which fertilizer boost yield of maize. Only percent of phosphorus was changed due to plant population density. Plant tissue concentration at silking was significantly influenced by fertilizer rates. Potassium is at sufficiency range for all level of supplied fertilizer. Sufficient range nitrogen at silkin was recorded from the plot received 100-150 kg/ha which gave economically feasible yield. It is better to use fertilizer rate of 150kg/ha which shows sufficiency range for nutrient concentration of soil and plant tissue in leaf at silking stage. This finding is not the end for the area and further research should be carried out for feature.
Keywords:plant tissue, soil, Zea mays L., Nitrogen, Phosphorus, Sulfur, potassium
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1. INTRODUCTION

Nitrogen, Phosphorus, Potassium and sulfur are the nutrients frequently limit the yield potential of maize over the world because these nutrients are important for plant growth and development. Nutrient recommendation for maize crop should be based on the optimum yield of the crop and environmental save (R.S. Mylavarapu 2010). This is the enabling the use of originally present nutrients in the soil and the added nutrient through fertilizers to the soil (Guillermo *et al*, 2015).This can be managed through plan tissue testing and soil testing technologies

Plant tissue testing is the process of testing the nutrient concentration in some part of plant organ in case of maize in the leaf at the silking stage of the crops to adjust optimum yield potential and sometimes for the next crop season based on the nature of the crop. This process is as check in fertilizer management in different crops as well as maize. Plant tissue analysis determines essential nutrient concentrations in sampled plant tissues and it is considered as the plant medicines and that can be related with yield and yield components of maize at silking stages. This technique also helps when there is suspect plant nutrient deficiency (Muhammad S. *et al*., 2012)

Optimum maize yield relates with soil fertility and the nutrient concentrated in that soil. It also relates with the soil physical and chemical properties. Decline in soil fertility in the study area is one of the major problems of maize production (Zelleke *et al.*, 2010; Belay, 2015). Lack of optimum organic and inorganic fertilizers for the maize growers are also another major problem. The farmers of the study area neglected the role of micro nutrient in maize productivity. The Etios's map indicates the existence of deficiency of boron and sulfur however; no serious consideration is given to the supplementation of these nutrients in the study area. Even though the role of sulfur and boron in the plant growth and development is significant, the growers of maize in the study area are not aware these elements to supply adequately. Maize is one of the most important crops in achieving food security for the study area. However, the optimum fertilizer rates of the variety are found to be major research gaps in the study area. Therefore, optimum fertilizer rates are considered to be one of the major reasons for the low maize production and productivity of the study area.

There was no also optimum plant density for every varieties newly released based on their morphological characteristics (Begizew and Adunga, 2017). As a result the farmers of the study area incurred low maize yield since they have no optimum fertilizer rates and plant population per unit area for every varieties.

Over population or under population of plant per unit area is another crucial problem in the study area. The other problem is that the farmers of the area planting all varieties with similar spacing. In developing countries, increasing maize plant population to the optimum plant density with optimum fertilization and good management; increased maize yield substantially. In Bako area still the average grain yield on the farmer's field is limited bellow 3.5 ton ha^{-1}(CSA, 2017) but in other nations the production of maize is above 10 tone ha^{-1}. This might be due to the contribution of in-sufficient amount of fertilization and in-optimum plant population per unit area.

1.1- Specific objectives

1. To evaluate the effect of NPSB Fertilizer rates on plant tissue concentration and soil nutrient concentration and relates with yield and yield components of maize
2. To evaluate the effect of plant population on plant tissue concentration and soil nutrient concentration and yield of maize
3. To determine the economic optimum levels of NPSB fertilizer rate and plant population for maize production by relating plant tissue concentration with yield of maize and soil fertility and its physical and chemical properties

2. MATERIALS AND METHODS

2.1. Description of the Study Site

The experiment was conducted at Bako Agricultural Research Center in east Wollega Zone, Oromia National Regional State in 2019 main cropping season under rain fed conditions. Bako Agricultural Research Center is geographically located at 9^o 06' N and 37^o 09'E latitude and longitude respectively. The study area is far away about 260km in the west direction of Addis Ababa. It is in mid-altitudes about 1650m.a.s.l. Rain fed agriculture is most popular in the area as it receives an inconsistent rainfall (1220 mm/annum) throughout the crop growing season (Mekonnen, 2018). The rain fall starts at the mid of April and ceases by the end of September and sometimes extends up to mid-October or early November. Maximum rainfall is usually received in June to October. The average temperature is 21.7^{0}C and the dominant soil texture of the research area was clay soil (Table 1).

2.2. Data collection

2.3. Soil Sampling and Analysis

The composite initial sample of pre-planting and post-harvest samples (plot based) on the surface of 0-20 cm were taken from the experimental site following the procedure of taking surface soil sampling. After harvest at each plot five samples were collected in X pattern and composited for analysis. The samples were taken to BARC laboratory and Ethiopian water design works for soil nutrient analysis. The pre-planting soil physical properties were determined Using Hydrometer method (Bouyoucos 1962) include soil moisture content, soil texture, bulk density using core method (Grassman and Reinch 2002) and particle density also determined by pycnometeric method (Bouyoucos 1962).

The soil chemical properties studied include soil pH, exchangeable bases (Ca, Mg,K), organic carbon, organic matter, total nitrogen, available phosphorus, and sulfur. Soil pH was determined using a pH meter with combined glass electrode in water (H_2O) at 1:2.5soil: water ratio as described by Carter (1993). Organic carbon was determined by oxidizing carbon with potassium dichromate in sulfuric acid solution following the Walkley and Black method (1934). Finally, the organic matter content of the soil was calculated by multiplying the organic carbon percentage by 1.724 (Broadbent, 1958). The total nitrogen content in soil was determined using the Kjeldahl procedure by oxidizing the organic matter with sulfuric acid and converting the nitrogen into NH_4^+ as ammonium sulphate (Sahlemedhin and Taye, 2000). Exchangeable acidity was determined by saturating the soil samples with potassium chloride solution and titrated with sodium hydroxide as described by Mclean (1965). Exchangeable bases (Ca, Mg, K and Na) in the soil were estimated by the ammonium acetate (1M NH_4OAc at pH 7) extraction method. In this procedure, the soil samples were extracted with excess of NH_4OAc solution, and Ca and Mg in the extracts were determined by atomic absorption of spectrophotometer (Anderson and Ingram, 1996).

2.4. Plant Tissue Analysis

When the crop reached the silking stage, the representative leave samples of ear leave were taken from each plot per treatment. Five ear leave from each plot were collected and composite of each treatment was mixed together or fifteen leave per treatment. The samples were oven dried and grounded pass through 0.01mm sieve using grander machine for laboratory analysis of total N, P, S and K. The measurement of N was carried out according to the Kjeldahl procedure by transforming organic N into ammonium N by digesting with H_2SO_4 and a catalyst

(Chapman, 1965). The measurement of P concentration of leaf was carried out through calcinations of it separately at 450 °C. After calcinations, wet destruction of plant substances with strong acids were carried out, and then P was measured using dry ashing (flame Photometer) as described by Chapman (1965). Potassium was determined by flame photometer of the dry ashing maize samples. Total Sulfur was analyzed using Calorimeter (Chapman, 1965).

2.5. Statistical Analysis

The collected agronomic data, soil data and leaf nutrient content were subjected to Analyses of variances using computer software Genstat-15 (Laes Agriculture Trust, 2012) software. Least Significant Difference (LSD) test at 5% probability was used for mean separation when the analysis of variance (ANOVA) indicates the presence of significant differences of the mean of the treatments.

3. RESULTS AND DISCUSSION

3.1. Physicochemical properties of the soil

3.1.1. Pre-planting soil analysis

The physicochemical properties of the soil of the study area at the pre-planting are shown in Table 4. The soil contains 59% clay, 6% silt and 35% sand, which is categorized in to clay soils according to soil textural classification (Tadesse, 1991). The soil reaction of the experimental site was moderately acidic with a pH of 5.74 as described by Murphy (1968) and (Tadese, 1991). Similar results were obtained by Fassil and Charles (2009) who reported that in western part of Ethiopia the soils tends to acidic soil.

The organic matter content of the experimental site soil was recorded as 5.21% which was considered as medium and stable (Musinguzi *et al*., 2013). According to them soils in Sub-Saharan Africa can nourish crops if the soil organic matter content is more than 3.4% based on the soil textural class that can hold the nutrients for plant growth and development. The optimum SOM also improve the buffering capacity of the agricultural soils based on the soil textural class and decomposed organic materials (Murphy *et al*., 2014). However, the amount of organic carbon content recorded was categorized as low 3.06 %, (Landon, 1991).

Therefore, the experimental soils qualify for medium in total N and low in organic carbon. The very low organic carbon and medium in total nitrogen content of the study area indicate low fertility status of the soil. This result is similar with Bekele *et al*. (2016) who reported that very low OC and very low to medium N content indicated low fertility status of the soil. This is also in line with the reports of Woldeamlak and Leo (2003) and Achalu *et al*. (2012).

The available phosphorus was found to be 11.8 (ppm) that was considered as medium, (Taddesse, 1991) hence addition of phosphorus fertilizer to the soil of study site expected to increase grain yield. These results are in agreement with findings of EthioSIS, (2015) and Endalkachew *et al*., (2018) who reported that cultivated land in Ethiopia regularly shows low available phosphorus to the crop. The available sulfur concentration of the study site was found to be 68.76 mg kg^{-1} soil. According to NFDC, (1992) it falls in the range of adequate.

The status of Ca in tested soils (16 Cmol (+) kg^{-1}) has been ranges with in high ranges (London 1991). The percent of exchangeable potassium in studied soils had 0.39 Cmol (+) kg-^{1}found in low according to Landon, (1991) rating. The soils in the study area had low K, indicating that these soils have no adequate levels of K for crop production. The result disagrees with the common idea that Ethiopian soils are reach in K. But it agrees with Belay (1996) and Wakene (2001) who reported K deficiency in Eutric Vertisols of Melbe (Tigray) and Dystric Nitisols of Bako area, respectively

Table 1. Physicochemical properties of soil of research site

Soil property	Mean value
BD (g/m3)	1.54
Moisture content	25.2
Sand (%)	35
Clay (%)	59
Silt (%)	6
Textural class	clay
pH	5.74
OC (%)	3.02
OM (%)	5.21
TN (%)	0.26
Av.P (ppm)	11.8
EMg (meq/100gsoil)	7
ECa (meq/100g soil)	16
K (%)	0.39
Av.S (mg/kg)	68.76

Mg=milligram, BD=bulk density, OC=Organic carbon, OM=organic matter, TN=total nitrogen, AvP=available phosphorus, EMg=exchangeable magnesium, ECa=exchangeable calcium, Av.S=available sulfur

3.1.2. Post-harvest soil analysis

There was significant difference ($P<0.05$) on available phosphorus and soil pH of the soil after harvest among treatments (Table 2). Nevertheless, available nitrogen, organic carbon, organic matter, exchangeable magnesium and exchangeable calcium nutrient content were not significantly affected by NPSB fertilizer treatments. The post- harvest soil analysis indicated that the highest available phosphorus 14.057 ppm was recorded from the plot treated with standard check 69/92 kg NP ha^{-1} that exceeded the pre-plant soil result 11.8 ppm and it was followed by 11.643 ppm available phosphorus from the plot with 250kg NPSB ha^{-1} fertilizer rate. The least available P 5.380ppm was recorded from control. Similarly, available phosphorus 7.52, 8.22 and 6.49 ppm were recorded from treatment 100, 150, and 250 kg NPSB ha^{-1} respectively, which was statistically at par with the pre-plant soil available Phosphorus (Table 2). This result was similar with the finding of Fekadu *et al*. (2018) who reported that increase inorganic fertilizer rate reduces soil pH value or acidifies the soil.

Application of NPSB fertilizer reduced soil pH or acidifies soil after harvest. In the plots that were with control and 100 kg NPSB ha^{-1} fertilizer rate, pH of the soil was higher than the other treatments (pH recorded were 5.486 and 5.477 respectively). The rest treatments increased the acidity of the soils as compared with the control and 100 kg NPSB ha^{-1} which could be due to the increases in acidification of the soil (Table 2). High application of inorganic fertilizers such as phosphorus, Nitrogen and sulfur acidifies the soil based on the form of nutrient in fertilizer and rain fall of the study site (Fikadu *et al.,* 2018).

Table 2. Effect of NPSB fertilizer rates on nutrient content of post-harvest soil

(NPSB kg ha^1)	pH	TN (%)	AP (ppm)	OC (%)	OM (%)	Ex.Mg (meq/100gsoil)	Ex.Ca (meq/100gsoil)
Control	5.486a	0.2144	5.380e	2.490	4.292	8.56	16.33
69/92(NP)	5.233b	0.2044	14.057a	2.372	4.091	12.78	16.44
100	5.477a	0.2200	7.519cd	2.536	4.371	9.78	21.11
150	5.364ab	0.2100	8.217c	2.424	4.180	10.56	16.67
200	5.288b	0.2044	6.491de	2.382	4.109	10.17	19.94
250	5.303b	0.2378	11.643b	2.751	4.739	9.89	16.78
LSD (5%)	0.1368	Ns	1.62	Ns	Ns	Ns	Ns
CV (%)	2.7	23.1	18.9	22.8	22.9	66.3	25.2

Means with the same letters shoed there was no significant difference among treatments, TN= total nitrogen, AP=available phosphorus, OM=organic matter, OC=organic carbon, Ex.Ca=exchangeable calcium, Ex.Mg=exchangeable magnesium,

There was significant difference ($P< 0.05$) among treatments of plant population on available P of the soil after harvesting (Table 3). However, plant population didn't affect significantly ($P<0.05$) parameters like percentage of total nitrogen, percent of organic carbon, organic matter, exchangeable magnesium, exchangeable calcium and soil pH (Table 3).The highest available P 12.234 ppm in the soil after harvest was recorded from the plot with plant population of 53,333 plants ha^{-1} followed by 8.645 ppm of available P from the plot with 76,923 plants ha^{-1}. The lowest mean of available P of 5.775 ppm was recorded from the plot with 66,666 plants ha^{-1} (Table 3). This result might be due to the competition of plants for nutrients and the plot with the optimum fertilizer plants extracted the P in the soil and the mean of available P was low. The low available phosphorous of the studied area might be due the low soil pH, while block the available P of the experimental area

Table 3. Effect of plant population on nutrient content of the soil after harvest

Plant population ha^{-1}	pH	TN (%)	P (%)	OC (%)	OM (%)	Ex.Mg(meq/100gsoil)	Ex.Ca (meq/100gsoil)
53,333	5.184	0.2178	12.234a	2.502	4.314	9.06	16.50
66,666	5.512	0.2200	5.775c	2.555	4.404	11.61	18.11
76923	5.379	0.2078	8.645b	2.421	4.172	10.19	19.03
LSD(0.05)	Ns	Ns	1.63	Ns	Ns	Ns	Ns
CV (%)	2.7	23.1	18.9	22.8	22.9	66.3	25.2

Means with the same letters showed there was no significant difference among treatments, TN= total nitrogen, AP=available phosphorus, OM=organic matter, OC=organic carbon, ECa=exchangeable calcium, EMg=exchangeable magnesium, ns=non-significant

3.2. Plant Tissue Analysis

There was significant difference ($P<0.05$) among treatments on nutrient concentration in the leave at silking stage (Table 5) and interaction of fertilizer rates and plant population had no statistically significant difference on plant tissue nutrient concentration at silking stage of ear leaf. The application of different rates of NPSB fertilizer changed the nutrient contents in the plant tissue at silking stage. The highest K percentage in the leaf 2.25% was recorded from the standard check 92/69 kg NP ha^{-1} followed by the control 2.19% of K, while the least 1.92% K was recorded from the plot that received 250 kg NPSB ha. This result showed that the amount of K in ear leaf was categorized as sufficiency range concentration in all plots based on the rating of (Jones *et al*., 1990) that the concentration of K 1.3-3% is considered as sufficient. The result is in agreement with Witold *et al*. (2014) reported 1.3-3% K concentration showed the sufficiency for plant growth. The low K percentage in the plot that received highest rate of fertilizer 250 kg NPSB ha^{-1} might be due to the fumigation effect of H_2S that can affect the nutrient concentration of leaf of the maize and other plants (Hancock *et al*., 2011; Martin *et al*., 2016)

The content of N in the plant tissue also affected by the NPSB rates at the level of significance ($P<0.05$). The highest 1.86 % of N was recorded from the plot with 250 kg NPSB ha^{-1} fertilizer rate, followed by the plot with 150 kg NPSB ha^{-1} fertilizer rate and which gave 1.76% N; while plots that received 92/69NP, 100, and 150 were statistically par (Table 5). Likewise Ahemad *et al*., (1999) reported that increasing level of fertilizer increases the N content in the plant tissue of maize. The reason may be the increasing in fertilizer rate or the amount of Sulfur in fertilizer may facilitate the N in the plants that the interaction effect of N and S in plant metabolism is positive effect or synergetic (Gulzar *et al*., 2009).

The highest phosphorus percentages 0.266, 0.226 and 0.223 % were recorded from the plots treated with 150, 100 kg NPSB ha^{-1} and control fertilizer rate, respectively, which was statistically par with 250 kg NPSB ha^{-1} fertilizer rate with 0.218 % of phosphorus. The lowest percentage of Phosphorus 0.19 and 0.21% was recorded from the plots treated with 200 kg NPSB ha^{-1} and 92/69 kg NP ha^{-1} fertilizer rate. The treatment with highest concentration in plant tissue for P revealed optimum grain yield that the tissue concentration and grain yield in maize was related in this result (Table 5). This result was in line with Andrew (2015) who reported that as treatment increased plant tissue concentration, grain yield was also increased with a positive response. This is also in agreement with the result of Baker *et al*., (2013) who reported that application of optimum fertilizer resulted in maximum nutrient in the leaf of the plant. This result may be due to the optimum rate of the blended fertilizer that the plant may use the nutrients optimally (Andrew, 2015).

Percentage of Sulfur in plant analysis was influenced by fertilizer rates at ($P< 0.05$). The highest percentage of Sulfur (0.10333%) was recorded from the plot treated with 100kg/ha NPSB fertilizer rate, followed by the plot treated with control which gave 0.1%. The rest plots treated with different levels of fertilizer gave similar percentage of Sulfur (Table 5). This result agreed with Baker *et al*., (2013) and Rahul *et al.,* (2017) who reported that % N, % P, % K and % S below the critical value reduce yield of maize by 5-10%. As per their report 3%N, 0.25%P, 2.0%K and 0.12%S concentrated in plant tissue at tasseling to silking growth stage in the ear leaf were the critical value. Similar result was reported by (Jasim *et al*., 2016), as the percentage of N concentration in the plant was very low, the yield decreasing in grain yield is observed.

Table 4- Effect of NPSB fertilizer rates on plant tissue nutrients content in percent

NPSB kg/ha	Potassium	Nitrogen	Phosphorus	Sulfur
Control	2.190a	1.700bc	0.2233a	0.10a
69/92(NP)	2.252a	1.736b	0.2086bc	0.08b
100	2.166ab	1.712b	0.2262a	0.10a
150	2.034c	1.766b	0.2261a	0.07b
200	2.087bc	1.630c	0.1943 c	0.07b
250	1.924d	1.860a	0.2184ab	0.07b
LSD (5%)	0.059	0.049	0.009	0.010
CV (%)	2.9	3.0	4.6	12.0

There was significant ($P< 0.05$) difference among treatments of maize plant population on nutrient content of maize leaf at silking stage (Table 6). The percentage of K in the leaf at silking stage was influenced by the plant population per unit area. The highest K concentration in a plant tissue (2.186 %) was recorded from the plot with 76,923 plants ha^{-1} (65 x 20cm) followed by the plant population of 66,666 plants ha^{-1} (65x25cm) from which 2.107 % of K concentration in plant tissue was recorded. The lowest K concentration in plant tissue 2.036 % was recorded from the plot with 53,333 plants ha^{-1} (75x25cm). High plant density resulted in maximum K concentration in the leaf of maize at silking stage (Table 8). The result falls in the sufficient category Jones *et al*. (1990) who reported that in leaf tissue at silking stage should have 1.3-3 % K concentration for normal crop growth.

In the range of low K concentration in maize ear leaf K concentration yield reduction is happen due to the influence of K in maize physiological activity and the impact of on other nutrients in plant tissue (Robert, 2017). Potassium also absorbed actively by the plant and its deficiency is not observed in ear leaf of maize since it is highly mobile and goes to the top part of the plant (Steele *et al.,* 2012). Likewise, Krzysztof *et al.* (2016); Jordan *et al.* (2008) who reported that analysis of different organs of the maize, the leaf tissue show sufficiency range of nutrient concentration.

There was significant ($P< 0.05$) difference among plant population treatments on nitrogen percentage on leaf tissue at silking stage. The highest amount of nitrogen percentage (1.765) was recorded from the plot with 66,666 plants ha^{-1} (65x25cm) followed by the plot received both plant population 53,333 plant ha^{-1} and 76923 plants ha^{-1} which gave similar means of N percentage 1.71 with 53,333 plants ha^{-1} (Table 6). Cailong et al. (2017) reported increasing plant density from lower to the optimum N concentration increase up to certain level. At the highest plant density might be in nutrient absorption from the soil and the nutrient in the plot received 76,923 plants ha^{-1} reviled low nutrient concentration in the leaf (Peng *et al.,* 2017). The mean of percentage of P in the plant tissue was affected by plant populations (Table 6). The highest P percentage (0.2272%) was recorded from the plot with 76923 plants ha^{-1} followed by the plot with plant population of 66,666 plants ha^{-1} from which 0.2073% P was recorded, and statistically par with the plot received 53,333 plants ha^{-1} (Table 8). This result may relate with the utilization of the plants that the lower denser plants used and transformed nutrient in their leave, root architectures, environmental condition and soil of the area on which plant grows; and interaction of nutrients can affect the nutrient in the plant tissue (Fageria, 2006). Analysis of variance also depicted that the mean of percent of S in the plant tissue was influenced significantly ($P< 0.05$) by plant population. The highest mean (0.135) was recorded from the 76923plants ha^{-1} followed by mean of 0.078 from the plot with plant population of 53,333 plants ha^{-1}. The lowest sulfur content (0.037) was recorded from the plot with 66,666plants ha^{-1} (Table 5). The nutrient S concentration in the plant tissue were not similar in the three plant densities, this might be happened due to crop morphology (Fageria, 2006).

Table 5. Effect of plant population on plant tissue nutrient concentration in percent

Plant population/ha	Potassium	Nitrogen	Phosphorus	Sulfur
53,333	2.036c	1.718b	0.2140b	0.078b
66,666	2.107b	1.765a	0.2073b	0.04c
76923	2.186a	1.718b	0.2272a	0.14a
LSD (5%)	0.042	0.035	0.011	0.011
CV (%)	2.9	3.0	4.6	12.0

4. CONCLUSION AND RECOMMENDATIONS

From the result we have concluded that at pre-harvest soil reaction of the study area is moderately acidic and its organic matter content is medium and stable with low organic carbon. It is also with low nitrogen content and medium available phosphorus and show that low soil fertility. After application of NPSB in organic fertilizer, post-harvest soil analysis show nutrient in the soil show increment of available phosphorus and nitrogen and sulfur of that soil. The only potassium of the experimental area was not increase. Wen plant tissue is analyzed, leaf nutrient concentration at silking stage influenced by level of fertilizer that the level 150kg/ha show optimum nutrient concentration at that range the yield increases. Therefore, farmers of that area is advised to use this level of fertilizer and this finding is not the end finding but it need further research

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