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# Response of Potato(Solanum tuberosum L.)to Potassium Fertilizer on Acid Soils of Wolmera and Gumer Weredas,in the High Lands of Ethiopia

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**Abstract**
An experimenton the effect of K fertilizer on potato was conducted under on station and on farm condition ofHoleta, Bedi and Gumer weredasin 2012 and 2013 cropping seasons. The experiment comprised of eight treatments with 3 replicationsarranged in RCBD design. The treatments were absolute control, recommended rate of NP(165 kg ha$^{-1}$ urea and 195 kg ha$^{-1}$ DAP), recommended rate of NP combined with 25, 50 and 75 kg ha$^{-1}$ $K_2O$ (From potassium sulfate ($K_2SO_4$)and potassium chloride (KCl). DAP was applied as basal application at planting whereas urea was applied in split i.e.half at planting and the rest half one month after planting. $K_2SO_4$ and KCl were used as K sources and were applied as basal at planting. Potato variety Gudane was used as test variety at all locations. Results combined over years and sites showed that the highest potatotuber yield and number of tubers per meter square was obtained from the plots that received 75 kg ha$^{-1}$$K_2O$from $K_2SO_4$. At all sites allrates and types of K fertilizer applied had significantly increased tuber yield with the benefit ranging from 60 to 149% over the control. The pooled data in each location indicated that both types of K fertilizers and all K rates gave significantly higher tuber yields (ranging from 24.1 to 32.4 t ha$^{-1}$) as compared to the recommended rate of NP (20.8 t ha$^{-1}$). Particularly the application of $K_2SO_4$ gave significantly higher tuber yieldsof potato than that of KCl receiving similar rates at Bedi and Holeta, but not at Gumer site.
**Keywords**: soil acidity, potassium,highlands, lime, potato

## 1. Introduction

Potato (*Solanum tuberosum* L.) is one of the most economically important crops in Ethiopia that play key roles in food security and cash income for small-holder producers. Over a century and two decades, potato in Ethiopia grew from a garden crop in few regions to a staple crop produced in many regions under different agro-ecological conditions. For nearly a century, however, the growth in potato production and productivity was gradual and low.However; most of the agro-ecologies in Ethiopia have favorable climatic and edaphic conditions having a huge potential to produce high quality potatoes.

Currently potato is planted onaround 74,935 hectares producing an estimated total tuber yield of 863,348tonsCentral Statistical Authority (CSA, 2013). This implies that the average yield in the country isonly 17.4 t ha$^{-1}$ while the potential for small holder is estimated around 25 tha$^{-1}$. Even though many improved varieties of potato were released and made available for users to fill the gap, their full potentials of these varieties could not be exploited partly due to lack of proper nutrient management practices. Moreover, potato is grownonnitisols where the soils are highly depleted of essential inherent nutrients and having soil acidity problem.

Most of the previous work on potato nutrition in Ethiopia were limited to determination of nitrogen and phosphorus requirements the crop. The use of potassiumwas almost neglected in most studies due to a long standing understanding that Ethiopian soils were not deficient of potassium. This, however, may not hold true always as soil fertility status is a dynamic process and varies from soil to soil and from one agro-ecology to the other.

The beneficial effect of potassiumnutrition has beenwell documented in photosynthesis, increasing enzyme activity, improving synthesis of protein, carbohydrates and fats, translocation of photosynthetic, enabling their ability to resist pests and diseases. In addition, potassium is considered as the major osmotic active cation of plant cell (Mehdi *et al*., 2007), where it enhances water uptake and root permeability and acts as a guard cell controller; increases water use efficiency (Zekri and Obreza, 2009). Al-Moshileh and Errebi (2004) reported thatPotato plants require much more potassium than many other vegetable crops (It increases both the rate and duration of tuber bulking(Singh, 1999), and assists in the translocation of carbohydrates from leaves to tubers.

In the highlands of western and southern Ethiopia where nitisol is dominating, soil acidity and K deficiency are serious problems to crop production. Despite the application of sufficient amount of nitrogen and phosphorus fertilizers, lack of potassium has limited yield in acid soil conditions of Ethiopian highlands (Wassie Haile, 2009). However, there is no practice of potassium fertilizer application in these areas. On the other hand, farmers conventionally apply wood ash on their plots to increase productivity (Wassie Haile, 2009). Thus, this study was conducted with the objective of evaluating the response of two sources of potassium fertilizers in the highlands of Ethiopia.

## 2. Material and Methods

### 2.1. Site description

The experiment was conducted at Holeta research center under onstation conditions and farmers' fields at Bedi and Holeta in Wolmera weredainOromia special zoneand Gumerweredasin Gurage zone for two consecutive years (2012-2013). The sites are situated at 9$^0$05' 57N38$^o$ 36' 02'' E (Bedi), 8$^0$ 0' 21''N and 38$^0$ 6'28''E (Gumer), 9$^o$ 03' 23''N and 38$^o$ 30' 27'' E (Holeta) respectively.Composite soil samples were collected before planting for pH and exchangeable acidity (EA) determination. and from all plots after harvesting from 0-20 cm soil depth, and were analyzed for pH, available phosphorus (P), total nitrogen (N), organic carbon (OC), K, cation exchange capacity (CEC). Since the three sites were acid soils, lime was applied on the basis of exchangeable acidity of each site determined in advance and applied one month before planting. The lime rates were 2.7, 0.14 and 2.6 t ha$^{-1}$at Bedi, Holeta andGumer, respectively.

### 2.2. Experimental design and procedures

The experimental design was randomized complete block with three replications. There were eight treatments; control (no fertilizer), recommended rate of NP(165 kg ha$^{-1}$ urea and 195 kg ha$^{-1}$di-ammonium phosphate (DAP), recommended rate of NP combined with 25, 50 and 75 kg ha$^{-1}$ $K_2O$ from potassium sulphate ($K_2SO_4$); andrecommended rate of NP combined with 25, 50 and 75 kg ha$^{-1}$ $K_2O$from potassium chloride (KCl). Urea and DAPwere used as N and P sources, respectively. DAP was applied as basal application at planting whereas urea was applied in two splits; half at planting and the rest half one month after planting. Potassium sulfate ($K_2SO_4$) and Potassium chloride (KCl) were used as K sources and were applied once at planting. Gudane potato variety which is popular potato variety currently under production was used as a test variety at all locations for this experiment.

Analyses of variance were performed using the SAS statistical program SAS Version 9.2(SAS, 2001). Analyses of variance for tuber yield wasdone for all seasons after pooling data over years. Whenever treatment differences were found significant based on results of F-test, mean separation was done by employing Tukey multiple comparison test.

## 3. Result and Discussion

### 3.1. PotatoTuber yield

Response of potato to different rates and sources of K fertilizer are presented in tables 1 and2. Results indicated thatpotato tuber yield was significantly affected by application of different types of potassium fertilizers and rates. Similar yield response trends to treatment effects were also observed during two years of investigation.

Results at Bedi, Holeta and Gumer sites indicated that all rates and types of fertilizer application in the two production year (2012 and 2013) had significantly increased potatotuber yield (Table 1). The yield at Bedi, Holeta and Gumer sites due toapplications of 75 kg ha$^{-1}$ $K_2O$ had yield advantage of92, 100 and 117% over the control during 2012 cropping season respectively. The same treatment had yield advantage of 196, 161 and 186% over the control during 2013cropping season. This treatment had similar treatment differences trend from the recommended rate of NP fertilizer.

The yield obtained by application of RR of NP and 75 kg ha$^{-1}$ $K_2O$ from $K_2SO_4$ consistently gave the highest significant ($p \leq 0.05$) potato tuber yield as compared to control as wellas different rates and sources of potassium fertilizer. However, potatotuber yield recorded by application of50 kg ha$^{-1}$ $K_2O$ from $K_2SO_4$during 2012 at Bedi, Holeta and Gumer sites were not significantly different from applications of 75 kg ha$^{-1}$ $K_2O$ form $K_2SO_4$. Even though the yield obtained during 2013 by applications of 75 kg ha$^{-1}$ $K_2O$ from $K_2SO_4$ significantly superior, it was closely followed by application of 50 kg ha$^{-1}$ $K_2O$ from the same source.The poled over year result had yield advantage of60 to 149% at Bedi,67 to 122%at Holeta and 94 to 144% in years 2012, 2013respectively (Table 1). This finding is in agreement with work of Bisahnu et al (2006) who reported highest potato tuber yield (24.75 t ha$^{-1}$) with application of 50 kg ha$^{-1}$ $K_2O$ as basal and top dressed,in addition research work of Wassie and Shiferaw (2011)on acidic soils in southern Ethiopia indicates supplementation of K increased potato tuber yields by 197% over the standard N-P recommendation alone. The pooled data indicated that both types of K fertilizers and all K rates gave significantly greater tuber yields (ranging from 24.1 to 32.4 t ha$^{-1}$) compared to the recommended rate of NP (20.8 t ha$^{-1}$). This result areinconformity with the findings of Wassie Haileand Tekalign Mamo (2013)and Bansal (1999).

On the other hand, significant difference was observed between potassium sources at Bedi and Holeta site. Potassium sulfate gave significantly greater tuber yields (3.6-4.9 and 2.9 –3.5t ha$^{-1}$ increment) than that of potassium chloride receiving similar rates at Bedi and Gumer respectively.The result indicted potato tuber yield increases with the application of $K_2SO_4$ than KCl applied at the same rate. This finding is in agreement with findings of Moshileh and Errebi (2004) who reportedincrease in marketable potato tuber yield significantly

 

(P<0.05) with increasing K from $K_2SO_4$up to450 kg $ha^{-1}$.

Table 1: Potato tuber yield as affected by potassium fertilizers under acid soil condition at Bedi, Holeta and Gumer site

| Treatments | Bedi Tuber yield (t $ha^{-1}$) | | | Holeta Tuber yield (t $ha^{-1}$) | | | Gumer Tuber yield (t $ha^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2012 Season | 2013 Season | Pooled over years | 2012 Season | 2013 Season | Pooled over years | 2012 Season | 2013 Season | Pooled over years |
| Control (no fertilizer) | 18.9$^{c}$ | 7.2$^{f}$ | 13.0$^{f}$ | 20.8$^{f}$ | 12.2$^{c}$ | 16.5$^{f}$ | 14.2$^{d}$ | 9.9$^{e}$ | 12.1$^{f}$ |
| Recommended rate (RR) of NP | 26.9$^{b}$ | 14.6$^{e}$ | 20.8$^{e}$ | 27.3$^{e}$ | 25.2$^{b}$ | 26.5$^{e}$ | 19.4$^{c}$ | 14.6$^{d}$ | 17.0$^{e}$ |
| RR of NP+ 25 kg $ha^{-1}$ $K_2O$ ($K_2SO_4$) | 30.7$^{ab}$ | 21.1$^{cd}$ | 25.9$^{bcd}$ | 33.7$^{dc}$ | 27.0$^{b}$ | 30.4$^{c}$ | 25.4$^{b}$ | 21.7$^{bc}$ | 23.5$^{c}$ |
| RR of NP +50 kg $ha^{-1}$ $K_2O$ ($K_2SO_4$) | 33.1$^{ab}$ | 24.7$^{b}$ | 28.9$^{b}$ | 39.6$^{ba}$ | 29.1$^{ba}$ | 34.3$^{ba}$ | 28.2$^{ba}$ | 22.7$^{bc}$ | 25.4$^{bc}$ |
| RR of NP + 75 kg $ha^{-1}$ $K_2O$ ($K_2SO_4$) | 36.3$^{a}$ | 28.5$^{a}$ | 32.4$^{a}$ | 41.6$^{a}$ | 31.9$^{a}$ | 36.7$^{a}$ | 30.8$^{a}$ | 28.3$^{a}$ | 29.5$^{a}$ |
| RR of NP + 25 kg $ha^{-1}$ $K_2O$ (KCl) | 29.0$^{b}$ | 19.1$^{d}$ | 24.1$^{d}$ | 29.7$^{ed}$ | 25.2$^{b}$ | 27.5$^{de}$ | 21.5$^{c}$ | 18.3$^{dc}$ | 19.8$^{d}$ |
| RR of NP + 50 kg $ha^{-1}$ $K_2O$ (KCl) | 30.4$^{ab}$ | 20.3$^{d}$ | 25.3$^{cd}$ | 35.4$^{bc}$ | 28.2$^{ba}$ | 31.8$^{bc}$ | 25.7$^{b}$ | 21.6$^{bc}$ | 23.6$^{c}$ |
| RR of NP + 75 kg $ha^{-1}$ $K_2O$ (KCl) | 31.5$^{ab}$ | 23.5$^{cb}$ | 27.5$^{bc}$ | 38.0$^{ba}$c | 28.4$^{ba}$ | 33.2$^{bc}$ | 28.5$^{ba}$ | 25.4$^{ba}$ | 26.9$^{b}$ |
| LSD (0.05) | 6.2 | 2.5 | 3.04 | 5.4 | 4.7 | 3.5 | 3.6 | 4.5 | 2.49 |
| CV (%) | 11.9 | 11 | 10.5 | 9.21 | 10.38 | 10.18 | 8.58 | 12.72 | 9.57 |

Means within the same column followed by the same letters are not significantly different at P≤0.05.

### 3.2. Response of potato yield components to potassium fertilization

Yield components of potatosuch as number of tubers per square meter and average tuber weight were measured in both seasons for all sites. In both seasons similar response trends to treatment effects were observed. Similarly, significant differences in average tuber weight werealso observed at all locations. The highest tuber weights were obtained from application of 75 kg $ha^{-1}K_2O$combined with the recommended rate of NP fertilizer. This treatment had 9.7 g (17%), 27.6 g (45%) and 18.5 g (39%) weight advantage over the recommended rate of NP fertilizer at Bedi, Holeta and Gumer sites, respectively (Table 2).This is due to the fact that K fertilizer application increases the tuber size of potato. Similar to tuber yields, $K_2O$ applied as potassium sulfate gave relatively higher tuber weight advantagethan that of potassium chloride receiving similar rates (Table 2).

Table 2: Potato yield components as affected by potassium fertilizers pooled over yearsat Bedi, Holeta and Gumer sites

| Treatments | Average tuber weight (g) | | | Tuber number $m^{-2}$ | | |
|---|---|---|---|---|---|---|
| | Bedi | Holeta | Gumer | Bedi | Holeta | Gumer |
| Control (no fertilizer) | 54.3 | 61.7$^{c}$ | 38.1$^{d}$ | 25$^{d}$ | 25$^{d}$ | 32$^{e}$ |
| Recommended rate (RR) of NP | 58.3 | 60.7$^{c}$ | 47.5$^{c}$ | 38$^{c}$ | 39$^{c}$ | 37$^{d}$ |
| RR of NP + 25 kg $ha^{-1}$ $K_2O$ ($K_2SO_4$) | 57.8 | 75.5$^{b}$ | 56.8$^{b}$ | 47$^{ba}$ | 42$^{bc}$ | 42$^{ba}$ |
| RR of NP + 50 kg $ha^{-1}$ $K_2O$ ($K_2SO_4$ | 62.0 | 76.3$^{b}$ | 61.3$^{ba}$ | 48$^{a}$ | 45$^{cba}$ | 43$^{ba}$ |
| RR of NP + 75 kg $ha^{-1}$ $K_2O$ ($K_2SO_4$) | 68.0 | 88.3$^{a}$ | 66.0$^{a}$ | 50$^{a}$ | 48$^{a}$ | 46$^{a}$ |
| RR of NP + 25 kg $ha^{-1}$ $K_2O$ (KCl) | 59.7 | 62.3$^{c}$ | 55.1$^{bc}$ | 42$^{bc}$ | 43$^{cba}$ | 37$^{dc}$ |
| RR of NP + 50 kg $ha^{-1}$ $K_2O$ (KCl) | 59.3 | 71.0$^{bc}$ | 62.1$^{ba}$ | 44$^{ba}$ | 46$^{ba}$ | 39$^{dcb}$ |
| RR of NP + 75 kg $ha^{-1}$ $K_2O$ (KCl) | 60.8 | 78.3$^{ba}$ | 67.0$^{a}$ | 46.2$^{ba}$ | 48$^{ba}$ | 42$^{cba}$ |
| LSD (0.05) | 12.24 | 10.8 | 8.1 | 5.6 | 6.64 | 4.34 |
| CV (%) | 17.42 | 12.88 | 12.21 | 11.44 | 13.57 | 9.36 |

Means within the same column followed by the same letters are not significantly different at P≤0.05.

Tuber number per square meter had also showed increasingtrend, with application of K fertilizer, and significant differences in tuber number were observed at all locations. The amount of tubers produced per square meter were higher with application of 50 and 75 kg $K_2O$ $ha^{-1}$ applied in both forms of K fertilizer compared to the recommended rate of NP fertilizer (Table 2).

### 3.3. Changes in soil chemical properties

The soil analysis result before planting indicated that the pH and exchangeable acidity (EA) (meq/100g soil) at Holeta 5.3 and 0.11, Bedi 4.62and 2.14, and Gumer 4.5 and 2.7 respectively.From the pH indicated above the soil was strongly acidic at Holeta and very strongly acidic at Bedi and Gumer sites. Data intable 3, 4 &5showchanges in soil chemical properties due to application of K fertilizer in three test sites. Soil analysis results indicated that the soil pH is acidic at all sites; Organic carbon (OC) content of the soil and total N low at Holeta and medium at Bedi and Gumer (Table 3, 4 &5). Available P (Bray II method) is low and CEC is medium at all locations.

 

Table 3. Effect of potassium application on some soil chemical properties at Bedi.

| Treatments | pH | OC (%) | P (ppm) | CEC (Cmol kg$^{-1}$) | Total N (%) | K (Cmol kg$^{-1}$) |
|---|---|---|---|---|---|---|
| Control (no fertilizer) | 4.28 | 2.41 | 8.27 | 17.73 | 0.23 | $0.41^{c}$ |
| Recommended rate (RR) of NP | 4.29 | 2.41 | 8.57 | 17.79 | 0.24 | $0.45^{bc}$ |
| RR of NP + 25 kg ha$^{-1}$ $K_2O$ ($K_2SO_4$) | 4.32 | 2.43 | 9.11 | 18.39 | 0.24 | $0.48^{bc}$ |
| RR of NP + 50 kg ha$^{-1}$ $K_2O$ ($K_2SO_4$ | 4.32 | 2.45 | 9.21 | 18.72 | 0.23 | $0.53^{ab}$ |
| RR of NP + 75 kg ha$^{-1}$ $K_2O$ ($K_2SO_4$) | 4.39 | 2.45 | 9.98 | 19.6 | 0.23 | $0.58^{a}$ |
| RR of NP + 25 kg ha$^{-1}$ $K_2O$ (KCl) | 4.31 | 2.40 | 8.63 | 18.55 | 0.23 | $0.48^{bc}$ |
| RR of NP + 50 kg ha$^{-1}$ $K_2O$ (KCl) | 4.32 | 2.44 | 9.39 | 18.9 | 0.23 | $0.48^{bc}$ |
| RR of NP + 75 kg ha$^{-1}$ $K_2O$ (KCl) | 4.38 | 2.45 | 9.43 | 19.02 | 0.24 | $0.51^{ab}$ |
| LSD (0.05) | NS | NS | NS | NS | NS | 0.09 |
| CV (%) | 2.58 | 4.47 | 13.76 | 4.88 | 6.54 | 11.06 |

Means within the same column followed by the same letters are not significantly different at P≤0.05.

Exchangeable K is medium at Bedi and Gumer and high at Holeta. Except exchangeable K at Bedi and Holeta sites, all parameters were not significantly affected by both sources of potassium fertilizer applied (Table 3, 4 & 5). However, Potassium fertilizer applications substantially increased exchangeable K contents of the soil at Holeta and Bedi changesin K wereincreased linearly with the increase in K rates for both fertilizer sources at Bedi and Holeta (Table 3 & 4). This finding is in agreement with the work of (Bishanu et al 2006) who reported plots treated with 100 kg ha$^{-1}$ $K_2O$ yielded higher potato tuber yield than the control plots.

Table 4. Effect of Potassium application on some soil chemical properties at Holeta.

| Treatments | pH | OC (%) | P (ppm) | CEC (Cmol kg$^{-1}$) | Total N (%) | K (Cmol kg$^{-1}$) |
|---|---|---|---|---|---|---|
| Control (no fertilizer) | 4.76 | 1.83 | 7.08 | 18.56 | 0.16 | $0.86^{c}$ |
| Recommended rate (RR) of NP | 4.79 | 1.86 | 7.12 | 19.66 | 0.17 | $0.93^{c}$ |
| RR of NP + 25 kg ha$^{-1}$ $K_2O$ ($K_2SO_4$) | 4.90 | 1.87 | 8.11 | 19.74 | 0.17 | $1.04^{b}$ |
| RR of NP + 50 kg ha$^{-1}$ $K_2O$ ( $K_2SO_4$ | 5.35 | 1.87 | 9.06 | 20.42 | 0.17 | $1.12^{ab}$ |
| RR of NP +75 kg ha$^{-1}$ $K_2O$ ($K_2SO_4$) | 5.56 | 1.99 | 9.18 | 22.27 | 0.17 | $1.14^{a}$ |
| RR of NP + 25 kg ha$^{-1}$ $K_2O$ ( KCl) | 5.01 | 1.84 | 7.34 | 19.81 | 0.17 | $1.03^{b}$ |
| RR of NP + 50 kg ha$^{-1}$ $K_2O$ ( KCl) | 5.17 | 1.91 | 7.87 | 20.4 | 0.18 | $1.09^{ab}$ |
| RR of NP + 75 kg ha$^{-1}$ $K_2O$ ( KCl) | 5.28 | 1.98 | 8.1 | 20.49 | 0.17 | $1.16^{a}$ |
| LSD (0.05) | NS | NS | NS | NS | NS | 0.09 |
| CV (%) | 13.53 | 4.77 | 11.61 | 13.25 | 4.66 | 5.22 |

Means within the same column followed by the same letters are not significantly different at P≤0.05.

Exchangeable K content at Bedi was found in medium range, and the highest K rates applied in the forms of potassium sulfate and potassium chloride increased K values by0.18 (43%) and 0.11 (26%) over the control, respectively (Table 3). Whereas the changes in K obtained at Holeta was tremendous. Application of 75 kg of $K_2O$ ha$^{-1}$ in the forms of potassium sulfate and potassium chloride increased K value by 0.28 (33%) and 0.3 (35%) over the control, respectively. However, the change in pH, available P and CEC explained by the change in K sources and rates were small and insignificant (Table 3, 4 &5).

Table 5. Effect of Potassium application on some soil chemical properties at Gumer.

| Treatments | pH | OC (%) | P (ppm) | CEC (Cmol kg$^{-1}$) | Total N (%) | K (Cmol kg$^{-1}$) |
|---|---|---|---|---|---|---|
| Control (no fertilizer) | 4.31 | 5.24 | 4.32 | 24.09 | 0.43 | 0.22 |
| Recommended rate (RR) of NP | 4.35 | 5.83 | 4.42 | 25.54 | 0.45 | 0.22 |
| RR of NP + 25 kg ha$^{-1}$ $K_2O$ ( $K_2SO_4$) | 4.42 | 6.00 | 5.09 | 25.55 | 0.44 | 0.23 |
| RR of NP + 50 kg ha$^{-1}$ $K_2O$ ( $K_2SO_4$ | 4.43 | 6.01 | 5.12 | 26.16 | 0.44 | 0.24 |
| RR of NP + 75 kg ha$^{-1}$ $K_2O$ ( $K_2SO_4$) | 4.45 | 6.07 | 5.26 | 26.23 | 0.45 | 0.25 |
| RR of NP + 25 kg ha$^{-1}$ $K_2O$ ( KCl) | 4.41 | 5.72 | 4.89 | 25.38 | 0.44 | 0.21 |
| RR of NP + 50 kg ha$^{-1}$ $K_2O$ ( KCl) | 4.42 | 5.88 | 4.94 | 25.61 | 0.44 | 0.22 |
| RR of NP + 75 kg ha$^{-1}$ $K_2O$ ( KCl) | 4.45 | 5.89 | 5.27 | 26.09 | 0.45 | 0.26 |
| LSD (0.05) | NS | NS | NS | NS | NS | NS |
| CV (%) | 2.04 | 6.88 | 12.71 | 4.2 | 2.92 | 12.76 |

Means within the same column followed by the same letters are not significantly different at P≤0.05.

## 4. CONCLUSION

An important finding of this study is that application of potassium fertilizers applied in the forms of potassium sulfate and potassium chloride in combination with the recommended NP fertilizer rates increased potato tuber yield,average tuber weight, tuber number per square meter while maintaining and improving the soil resource base. The result of this study showed that there is clear evidence of the requirement of potato to K fertilizers application either in the form of $K_2SO_4$ or KCl. However, the response potato to K fertilizer was more pronounced to $K_2SO_4$. Therefore, for sustainable and higher productivity, potato production in the highlands of Ethiopia should entail the application of K fertilizer in the form of $K_2SO_4$. The results disprove the belief that soils of Ethiopian highland are developed from K-rich parent material, and not necessary to apply K fertilizers. The intensive cropping and the increased use of nitrogen fertilizer after long period might have lowered the availability of K in the soil. The current scenario indicates that response for potassium is observed in the highlands of Ethiopia particularly in acid soils where nitisol is dominating. This might be attributed to high nutrient loss through erosion and leaching.

This shows that the highest potato tuber yield production were obtained from the application of 50 and 75 kg K $ha^{-1}$ for both sources of fertilizers at all locations. Although both fertilizer sources significantly increasedpotato tuber yields, potassium sulfate was superior to potassium chloride in both yield and soil properties enhancements at all locations. However, this trial should be continued to assess the long-term effects of integrated use of NPK fertilizers along with liming in acid soils on soil physical and chemical properties, soil microbial activities, and interactions with other macro and micronutrient availability. Moreover, information on the economic feasibility and profitability of the nutrient management systems for potato production in small-scale farming systems of central highlands of Ethiopia also still needs to be addressed.

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