

Effect of Potassium on Tuber Yield and Yield Component of Potato (Solanium Tubersum) on Loamy Soils of Atsbi-Wenberta, Tigray, Ethiopia

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Abstract
An experiment was conducted to investigate the effect of different levels of potassium (K) fertilizer on the tuber yield and yield component of potato grown on loamy soils of Atsbi-Wenberta Wereda, Tigray, Ethiopia. The treatments were 0, 50, 100, and 150, kg/ ha K_2O. Nitrogen and phosphorus were applied at 110 N and 89.7 P_2O_5kg /ha, respectively to all plots. Potato variety Gudane was planted in with inter and intra row spacing of 70 cm and 30 cm, respectively. The experiment was laid out in RCB design with three replications. The result revealed that application of K has significantly increased, on days to flowering, average tuber weight, tuber diameter, and marketable and total tuber yield of potato compared with the control. The highest marketable (33.0t/ha) and total tuber yield (34.6t/ha) was obtained at K level applied at the rate of 100 kg /ha K_2O, it increased the total tuber yield from 27.26 t/ ha in the control to 34.6 t /ha. The highest total and marketable tuber yield increase by 29.2 and 26.92 %, respectively compared to the control was obtained due to K application at rates of 100 K_2O Kg/ha. Furthermore the partial budget analysis data showed that the highest net benefit and marginal rate of return (2450%) was obtained at K fertilizer application rate of 100 kg/ ha K_2O . It is concluded that application of K has significant and positive response to tuber yield and yield component of potato in the study area, the highest biological and economic yield was obtained at K level of 100 kg /ha K_2O indicating that soils of Atsbi-Wenberta area are deficient in K .Hence, it is recommended to apply K in the study area in order to attain optimum tuber yield, net income and return.
Keywords: Marketable yield, Potassium (K); Potato; tuber yield

1. Introduction

Potato (*Solanum tuberosum L.*) is the fourth most important crop in the world after wheat, maize and rice with 314.1 million tons of annual production on 18.1 million hectares of land (Arslanogul *et al*, 2011) .Potato is an important source of food which contains high levels of carbohydrate, protein, vitamins and minerals. It is also source income, and employment opportunity in developing countries (FAO, 2008). Due to its correct balance between protein and calories, it is considered a good weaning food and these traits make it an efficient crop in combating world hunger and malnutrition (Berga *et al.*, 1994). The commercial value of potatoes is increased considerably when they are processed into edible products that appeal to consumers on flavor, texture, appearance, and most of all convenience (Kirkman, 2007).Potato consumption has increased in the developing world, and over the last decade world potato production has increased at an annual average rate of 4.5 percent Furthermore; Kirkman (2007) has estimated that global consumption in processed form will increase from 13% of total food use in 2002 to nearly 18% by 2020.

In Ethiopia the potential yield of potato can reach up to 50 t/ha (Joshi, et al., 2009), but the average national potato production is 10.5 tones/ha, while progressive farmers who use improved agronomic practice attained yields of 25 tones/ha. Nutrient depletion is one of the bottlenecks for crop productivity in Ethiopia and, is strongly present in Tigray region. The phenomenon is a cumulative effect of top soil erosion on the steep slopes of the region, cultivation of marginal lands, neglect of fallowing, continuous cultivation of the arable land with limited external input, less crop residues and less manure from the cattle and overgrazing.

Potato is a high nitrogen (N), phosphorus (P) and potassium (K)-demanding crop. Deficiency of any or combinations of these nutrients can result in retarded growth or complete crop failure under severe cases (Khiari *et al.,* 2001). There was a general understanding that Ethiopian soils are rich in K and there was no need for its application based on the research conclusion of Murphy (1968) some 40 years ago. However, with time it is likely that in some soils deficiency of K could occur due to continuous mining, leaching loss, and soil erosion (Wassie *et al*., 2009). According to Abayneh *et al,*(2005**)** the results of soil chemical analysis data of samples from MARC station and its testing sites showed that in most of the soils the relative proportion of K to (Ca + Mg) is low, which may disrupt the availability of K and this could likely cause K deficiency in these soils**.** If the activity of calcium, Ca^{2+} and /or magnesium,Mg^{2+},increases, the plant uptake of potassium decrease. Conversely, if the activity of potassium, K^+ , increase the plant uptake of calcium and/or magnesium ,Ca^{2+} /Mg^{2+}, decreases. Thus, the potassium availability does not depend on the sole potassium content of soils, rather, it depends on the relative amount of the three cations ,K^+,Ca^{2+},Mg^{2+}.(Basak,1999). Inline to this Fasil and Charles (2006) reported that the northern high lands of Ethiopia 76% of the investigated soils are also deficient in potassium. In addition to this continuous cropping with no or insufficient K fertilization has impoverished soils of their native K fertility (Shahid and Moinuddin, 2001).Fertilizer type and application rates for potato have not been extensively studied in Tigray. The major inorganic fertilizer N and P have been applied mainly on the experience of other regions and there is no information regard to the influence of potassium fertilizer on potato production in the region. Moreover, very little information is available in the country with regard to the influence of potassium fertilizers on the growth, yield, and quality of potato. Potato has relatively high potassium requirement in comparison to other vegetables, and so potassium containing fertilizers should be applied in potato fields for high yield production. Adequate potassium fertilizer application can be useful because it makes potato plants adapted to the environmental stresses and may lead to increased resistance of potato to some pests AL-Moshileh *et al.*, 2005.

Therefore, systematic investigations the effect of potassium fertilizer rates on yield and yield component of potato under specific agro-ecology is very important to come up with relevant recommendations in order to help farmers to increase the productivity of potato.

2. Methodology

2.1 Description of the study area

The experiment was conducted at eastern zone of Tigray, Atsbi Wenberta wereda, Felegewyni Tabia 13^0 54' 53.98" N latitude and 39º 45' 02.61'' E longitude and 2764meter above sea level) which is located in Northern Ethiopia (Table 1). The experiment was conducted under rain fed condition from the end of June to early October 2012. During the study period 525mm rain fall was fall in the study area. The average annual rainfall, maximum and minimum temperature of Atsbi Wenberta, Felegewyni is 618.85 mm, 19.96 ^{0}c and 9.21 ^{0}C respectively with annual sunshine (hour) of 7.9 (hour) and wind speed 2.2 (Km/hr)(Table 1). The field experiment was conducted on loamy soil and the physical and chemical properties of the soil are presented in Table 2.This study site was selected based on their suitability interms of climate and soil conditions for higher potato production. With the increase in the introduction of irrigation technology, the potential for potato production in the study areas are growing also another criterion for selection.

Table1. Pre-sowing soil chemical and physical properties of the experimental site

Parameters	*Atsbi Wenberta (Felegewyni): - 0-30cm*
Electrical Conductivity or E.C (dS/m)	0.08
pH	6.4
Total nitrogen or N (%)	0.14
Available prosperous or P (ppm)	1.13
Available potassium or K (ppm)	62.5
Organic carbon or OC (%)	0.63
Cation Exchange Capacity or CEC (Cmol/kg)	15
Sand (%)	40
Silt (%)	37
Clay (%)	23
Textural class name	loam
Ca^{+2} (meq/100g soil)	4.8
Mg^{+2} (meq/100g soil)	2.6
K^+(Cmol/kg soil)	0.384
Na^+(Cmol/kg of soil)	0.217

2.2 Experimental treatments, design and producers

This study was conducted in order to study the effect of K fertilizer on tuber yield and yield components of potato. The treatments used consisted of four levels of potassium that was 0, 50,100& 150 Kg/ha of K_2O.The recommended N rate of 110 Kg/ ha and 90 P_2O_5 kg/ha was applied to all treatments equally. The entire rate of P, K and half of N fertilizers were applied at the time of planting. The remaining half of N was applied 45 days after planting. Urea (46% N), Triple Super Phosphate (46% P_2O_5), Potassium Chloride (62% K_2O) were used as fertilizer source for N, P and K respectively.

The experiment was laid out in Randomized Complete Block Design, with three replications. Medium size and well sprout Gudane variety of potato tubers were planted at spacing of between rows and plants 70cm and 30 cm respectively. A distance of 1 meter was maintained between plots and 1.5 meters between the blocks. The sowing depth was 12-13 cm and planting was done by placing a tuber manually per hill. Each plot size was four rows with 2.4 m long. Cultural practice such as weeding, cultivation and ridging were practiced per recommendation.

2.3 Data collection and procedures

Days to flowering were recorded when 50% of the plant population attained the flowering stage. Plant height was measured using a ruler starting from the base of the main shoot to the apex at full blooming. Number of stems per hill was recorded as the average stem count of five hills per plot at flowering stage, only stems arising from the mother tuber were considered for measurement. Days to physiological maturity was noted when the leaves of 75% of the plants in each plot was turned to yellowish color. Tuber number and yield were measured taking an average of 12 hills per plot. Healthy tubers with diameter > 3.5mm was considered as marketable , while rotten, diseased, insect attacked, deformed tuber and those having < 3.5 mm in diameter was categorized as unmarketable as described by (AL-Moshileh & Errebi, 2005). The average tuber fresh weight was recorded by dividing the total fresh weight of tubers per plot by the total number of fresh tubers.

Pre planting soil samples were randomly collected from the experimental site at 0-30cm depth with auger and a composite soil sample prepared. Tuber specific gravity was measured using the weight in air and weight in water method (Kleinkopf et al., 1987) .Starch content was calculated based on the Van Scheele equation. To determine, dry matter N.P and K content of tubers from five randomly selected plants per plot were taken at harvest washed, chopped and mixed. The sample was weighed while fresh and late dried in an oven at 80 ^{0}C for 72 hours and reweighted. It was calculated as the ratio between dry and fresh mass expressed as a percentage. Furthermore the dried sample ground and sieved then N,P and K content of the tuber was determined

2.4 Partial budget analysis

To analyze the costs and benefits in potato production a partial budget analysis technique was used as described by CIMMYT (1988). The marketable tuber yield data was adjusted by bringing down 10% to minimize plot management effect by the research or to reflect the actual farm level performance. The marketable mean tuber yield data produced by each treatment has been used for calculating the partial budget. The analysis was done using the prevailing market price for inputs at planting and for outputs at the time of harvest. All the costs and benefits were calculated on hectare basis in Ethiopian birr (Birr/ ha). The field price of a 1 kg of potato was 5.5 Ethiopian Birr(ETB) .A kg of KCL costs 16.5 Ethiopian Birr. 1 $ USD = 20 Ethiopian Birr. The gross benefit was calculated as average adjusted marketable tuber yield (t/ha) X field price that the farmers soled. Total variable cost (TVC) in this case is the cost of K fertilizer, application, and transport cost which varies across treatments. Net benefit was calculated by subtracting total variable cost from the gross benefit .Marginal rate of return (MRR) was also calculated as the ratio of differences between net benefits of successive treatments to the difference between total variable costs of successive treatments.

2.5 Statistical Data analysis

All crop data were tested their normality and subjected to General analysis of variance using Gen Stat version 13th edition. Whenever the treatment was significant Duncan test were used for mean separation between and/or among treatments. Simple linear correlations between parameters were computed when applicable to estimate the relationship between yield and yield components as affected by potassium using Minitab soft ware 14th edition.

3. Results and discussions

3.1 Effect of K fertilizer rates on growth parameters of potato

3.1.1 Days to flowering and maturity

The result have indicated that the effect of potassium fertilization was significantly influenced the days to reach flowering but not to attain physiological maturity in potato (Tables 2.). Application of K at the rate of 150 kg K_2O /ha delays flowering and maturity by 3 and 7 days respectively compared to unfertilized treatment. The lowest days to flowering and maturity was recorded in the control at both treatments. In general the present study concludes that the effect of K fertilization prolonged the days to flowering and maturity. In agreement to this study Ayalew and Beyene (2012), reported that potassium fertilization did not affect the time to reach physiological maturity. In contrast to this Mulubrhan (2004) and Ayalew and Beyene (2012) application of potassium did not affect the time to reach

3.1.2 Plant height

Shows that the main effect of K fertilizer rates were not significantly influenced the plant height at maturity. The tallest plant height 49.7 cm was recorded due to the effect K fertilizer rate at 150 Kg K_2O/ha. The lowest plant height 40.1 cm was obtained at the control compared to the fertilized treatments. In general the tallest plant height was obtained at the fertilized, where as the shorter at the unfertilized once. (Table 2)

3.1.3 Plant biomass yield

Potato biomass yield was not significantly influence by the effect K fertilizer rates, but fertilized potato was produced more biomass than the control. The highest (38.53 t/ha) and the lowest (31.26 t/ha) total biomass yield were obtained at the rates of 100 Kg K_2O/ha and the control respectively (Table 2). Positive and significant correlation was obtained with number of tubers (r=0.75*), marketable yield (0.98***) and total tuber yield (r = 0.98***) indicating that the existence of close association between them. In addition the biomass yield was correlated positively and none significantly to K ($r=0.54^{ns}$) application (Table 6). This indicates that with increasing K levels the biomass yield was increased and more responsive to K fertilizer.

3.2 Effect of K fertilizer rates on yield components of potato

3.2.1 Stem number per hill

The effect K fertilization was statistically significant to increase the stem number per hill at early maturity. The highest stem number per hill 4.68 was obtained at the effect of K application rate at 150 Kg K_2O /ha .The lowest stem number per hill was observed at the control (Table 2). In agreement to this study, Ayalew and Beyen (2012) reported that stem number of potato was influenced by the application of K fertilizer and was positively correlated with the applied K but most of the K rates gave a lower stem number though the stem number neither decreased nor increased with increasing the rates of K application. The positive effect of K fertilizer on the stem number per hill was further strengthened by the positive and non significant correlation observed with the applied K (r=0.42*). In addition, positive correlation was observed with the number of tuber per hill (r=0.33), marketable tuber yield (r=0.55) and total tuber yield (r=0.56) table (6)

Table 2. Main effects of Phosphorus and potassium fertilizer rates on growth parameter and yield component of potato

Treatment / K_2Orates kg/ha	Days to flowering	Days to maturity	Plant height (cm)	Biomass yield (t/ha)	Number of stems / hill	Tuber diameter (mm)
0	57.00^{c}	98.33	40.1	31.26^{c}	3.40	45.43^{b}
50	59.00^{b}	101.67	42.8	$.32,05^{bc}$	4.60	43.80^{b}
100	59.33^{b}	102.33	47.1	38.53^{a}	4.73	47.13^{b}
150	60.33^{a}	105.33	49.7	34.44^{b}	4.00	54.23^{a}
LSD (5%)	0.881	ns	ns	2.421	ns	4.391
CV(%)	0.7	2.6	8.1	3.40	18.5	4.6

Means of the same main effect within a column followed by the same letter are not significantly different at 5% of probability level = ns, and different letter are significant different at 5%, of probability level

3.2.2 Tuber number per plant

The number of tubers per plant was increased none significantly as the effect of K application rate increased. Moreover, the highest number of tubers per plant was recorded at 100 Kg K_2O/ha of K fertilizer application (Table 3). The positive effect of K fertilizer on tuber number was further confirmed by the positive and significant correlation between tube number per plant and the applied K (r= 0.41*). Positive and significant correlation values was also found between number of tubers and marketable yield (r=0.67*) and number of tubers and total tuber yield ($r = 0.67^{*}$) (Table 2).

3.2.3 Average Tuber weight

The effect of K fertilizer rates had highly significantly ($p \leq 0.001$) affected average tuber weight, as the K fertilizer rate increased the average tuber weight increase (Table 4) .The significance of K application was observed between fertilizer rates and the control and among the rates. The highest average tuber weight (60.70gm) was obtained at rate of 150 Kg K_2O/ha K, whereas the lowest average tuber weight (55.33gm) was obtained at the control (Table 4). In line to this study, Jenkins and Mahmood (2003) reported that the average tuber weight was generally much greater when all the three nutrients were supplied at a higher level. In addition, Panique *et al*. (1997) reported that the average tuber weight was increased in response to the application of K. The average tuber weight was positively and non significantly correlated with the applied K (r = 0.45) This indicated a closer relationship between the applied K with the average tuber weight and the yield advantage obtained due to K application could be attributed to its effect on potato tuber weight increment. The increase in average tuber weight of tubers in response to the increased supply of fertilizer nutrients could be due to more luxuriant growth, more foliage and leaf area and higher supply of photosynthesis which may have induced formation of bigger tubers thereby resulting in higher yields (Patricia and Bansal, 1999).

3.2.4 Effect of K fertilizer rates on tuber diameter

The effect of K fertilizer rates had significantly ($p \leq 0.05$) affected tuber diameter, as the K fertilizer rate increased the tuber diameter increase (Table 2). The highest tuber diameter was recorded at the highest K fertilizer rate (Table 2).Tuber diameter was also positively and none significantly correlated to the K(r=55) total tuber yield (r=0.0.87) and marketable yield(r=0.073) (table 6)

3.2.5 Effect of K fertilizer rates on specific gravity of potato

The effect of K fertilizer rates was not significantly influenced the tuber specific gravity. Moreover as application of K fertilizer rate increase, specific gravity increase none significantly. The lowest specific gravity was associated with control in relation to K fertilized treatments, where as the highest with K treated treatments. The potato of the specific gravity in this study was ranged 1.067- 1.083 gm/$cm^{3,}$ Higher the specific gravity the higher will be the quantity of dry matter and the greater the yield of produce. Potatoes with high specific gravity are preferred for preparation of chips and French fries. Potatoes with low specific gravity are used for canning. However, potatoes with very high specific gravity (1.10) may not be suitable for French fries production because they become hard or biscuit like. So purpose of growing potato should be kept in mind. The specific gravity is a measure of quality in potato tuber which is related to the dry matter contents in the tubers. In this study it was positively affected with fertilization. Similarly Mulubrihan (2004) reported that there was a significant decrease in the specific gravity due to the application of potassium. In contrary to this study Chapman *et al.* (1992) reported a higher specific gravity can found due to K application. Therefore, when quality is a requirement special consideration should be given to K fertilizer rate application.

3.2.6 Effect of K fertilizer rates on dry matter content of potato tubers

The effect of K was non- significantly decreased the dry matter content of potato tuber. With the increasing K rates from 0, to 150 kg/ha K_2O /ha the dry matter content of tubers decreased non significantly from 30.34 to 28.44 %, .The lower dry matter content (28.44 %) was recorded at 150 kg/ha K_2O /ha K fertilizer rate application . In agreement with this, Maier et al. (1994) and Kanzikwera et al. (2001) also reported that reduction in dry matter content was observed when rate of potassium fertilizer increased. However, Patricia and Bansal (1999) reported that application of K had no effect on tuber dry matter content. In Contrary, Tawfik (2001) reported that potato while was fertilized by high K rate had a significantly higher dry matter. The study also found that the dry matter was negatively and not significantly correlated with the application of K (r= - 0.51*)

3.2.7Effect of K fertilizer rates on starch content of Potato tuber (%)

The effect of K had no a significant influence on the starch content of potato tuber. Moreover as the K fertilizer rate increased the starch content of potato tuber was increased linearly .The highest (13.98%) starch content of tuber was obtained from the K application at 150 kgK_2O/ha . In agreement to this, Eleiwa *et al* (2012) reported that the chemical constituents of potato tubers like starch content was increased with increasing the NPK levels. In contrary, Eremee *et al* (2009) reported that fertilization of NPK reduced significantly the starch content of potato. According to Joudu (2003) the starch content of tubers was affected by a cultivation method, fertilization and storage conditions.

3.2.8 Effect of K fertilizer rates on harvest index

The effect K was not statistically significant influence in harvest index; there was no consistent an increasing trend in harvest index in response to increasing K fertilization. This may be attributed to an increased haulm growth in response to K treatment (Table 3).

Table 3. The main effect of P and K fertilizer on protein, starch, dry matter (DM) and specific gravity (S.G) of potato tuber

Treatment	% protein	starch %	DM (%)	S.G	Harvest index
K_2O rates kg/ha					
0	1.467	13.30	30.34	1.067	0.87
50	1.317	13.50	30.07	1.081	0.89
100	1.260	13.75	30.56	1.083	0.90
150	1.570	13.98	28.44	1.083	0.88
LSD(P<0.05)	ns	ns	ns	ns	ns
CV(%)	8.9	5.2	3.7	0.6	1.9

3.3 Effect of K fertilizer rates on potatoes total tuber yield

3.3.1 Total tuber yield

As shown in table 4 the effect of K fertilizer application showed that there was a significant difference in total tuber yields .As the application rate of K increase total tuber yield was increased significantly till the rate of K: 100 Kg K_2O/ha. The optimum tuber yield (34.60t/ha) was achieved due to the effect of K at the rate of 100 Kg K_2O/ha. The total tuber yield was increased in response to the effect of K fertilizer application (Table 4). In this study, it was found that the total tuber yield was more responsive to K fertilizer compared to the control. In general the lowest tuber yield was obtained at the control compared the treatments, which they were treated with K fertilizer. This study, also revealed a significant increase in total tuber yield was due to the application of K fertilizer, which seemed to prove that the soil, of Atsbi is poorer in K nutrient. In harmony with this study, Adhikari and Sharma (2004), Eremeev *et al* (2009) and Eleiwa *et al* (2012) reported that increasing the NPK levels significantly increased the tuber yield and the yield parameters of potato at harvest. The highest tuber yield was obtained from the application of K which is similar to the report by Tawfik (2001), Robert and

Monnerto (2000) and Haile and Boke (2011). Similarly, Zameer *et al* (2010) was reported a significant higher tuber yield with K application rate at K_2O 150 Kg /ha than NP treatment. In addition Westermann *et al.* (1994a) also reported a significant increment in tuber yield due to K fertilizer only on the K responsive soils. Ayalew and Beyene (2012) and Mulubrihan (2004) reported that application of K had a yield advantage over the control even if the difference was insignificant.

3.3.2 Marketable tuber yield

The productivity of potato it measured in terms of marketable tuber yield. The effect of K fertilization significantly affects the marketable tuber yield. There was also a significant difference in marketable tuber yield among the rates. The maximum marketable tuber yield (33.05 t/ha) was obtained due to the effect of K fertilizer at the rate of 100 Kg K_2O/ha K. Correspondingly, Eremeev *et al* (2009) reported that the total yield of tubers as well as the proportion of marketable tubers increased significantly with the use of NPK. AL-Moshileh and Errebi (2004) indicated that marketable tuber yield was significantly improved with increasing the potassium level. The correlation between the marketable tuber yield and the applied K ($r=0.55^{ns}$) were positive and not significant.

3.3.3 Unmarketable tuber yield

The study revealed that the effect of K was not significant affected the unmarketable tuber yield. The highest unmarketable tuber yield was obtained from the control (Table 4).In harmony with this finding, Mulubrhan (2004) observed a non significant influence of K application on un marketable yield.

Table 4. Effect of K fertilizer rates on Number of tubers per plant, Average tuber weight, marketable, unmarketable and total yield of potato

Treatment KO_2rates kg/ha	Number of tubers/plant	Average tuber weight (gm)	Marketable yield t/ha	unmarketable yield t/ha	Total (t/ha)
0	8.20	55.33^{c}	25.54^{c}	1.72	27.26^{c}
50	8.53	57.25^{bc}	26.99^{bc}	1.59	28.58^{bc}
100	9.67	59.17^{ab}	33.05^{a}	1.55	34.60^{a}
150	8.47	60.70^{a}	28.71^{b}	1.59	30.30^{b}
LSD (p<0.05)	ns	2.124	1.966	ns	1.859
CV(%)	7.8	1.80	3.4	6.9	3.1

Means of the same main effect within a column followed by the same letter are not significantly different at 5% of probability level = ns, and different letter are significant different at 5%, of probability level

3.4 Partial budget analysis

The partial budget analysis revealed that fertilizer application of K gave the highest gross profit, net return and marginal rate of return comparing to the control. The gross benefit of the control was 126423 Ethiopian birr /ha that was less than any fertilized treatment. The higher net income 161183.6 birr/ha were obtained from K fertilizer application at the rate of 100 Kg K_2O/ha (Table 5). The highest marginal rate of return (2450.03 %) was obtained from K fertilizer application at the rate of 100 Kg K_2O/ha (Table 5). The highest net income and net return were obtained as the result of K fertilizer application at different rates. The results showed that the rate of 150 Kg K_2O/ha K were dominated (D) by 100, Kg K_2O/ha indicating that the former level of K level treatment was less profitable than the later K level treatment. The fertilizer rates 100 kg K_2O/ha was proved to be the superior and economically viable for potato production in the study area (Table 5).

Table 5. Partial budget analysis data for K levels

K levels (kg/ha)	MYY (t/ha)	AMY(t/ha)	GBF (Birr/ha)	TVC (birr/ha)	NB (birr/ha)	MRR (%)
0	25.54	22.99	126423	0	126423.0	-
50	26.99	24.29	133617	1044.59	132572.4	588.69
100	33.05	29.71	163396	2212.38	161183.6	2450.03
150	28.71	25.84	142131	3100.08	139030.9	D

Figures followed by "D" are dominated fertilizer rate, MYY: Marketable yield, AMY: Adjusted marketable yield, TVC: Total variable cost, GFB: Gross field benefit, NI: net income, MRR: marginal rate of returns

Table 6. Correlation between the yield and yield components of potato

Number of stems per plant	1	-					
Total _biomass _yield_ t/ha	2	0.500^{ns}	-				
Total_ marketable _yield_ t/ha	3	0.551^{ns}	0.978***	-			
Total_ tuber_ yield_ t/_ha	4	0.557^{ns}	0.978***	1.00***	-		
Number _of_ tuber per _plant	5	0.332^{ns}	0.749*	0.669*	0.667*	-	
Average _tuber_ diameter _mm	6	-0.266^{ns}	0.215^{ns}	0.087^{ns}	0.073 ^{ns}	0.242 ^{ns}	-
		1	2	3	4	5	6

Non significant (ns) at P>0.05, Significant (*) at P≤0.05 and highly significant (***) P≤ 0.001

Conclusion and recommendation

It can be concluded that application of potassium has significantly and positively increased, biomass yield, average tuber weight, tuber diameter, marketable and total tuber yield of potato. The highest average tuber weight, number of tubers per plant, marketable and total tuber yield were obtained from K fertilizer application at the rate of 100 Kg K_2O/ha. The optimum tuber yield and net income were obtained from the application of K at the rate of 100 Kg K_2O/ha. This finding further disproves the report by Murphy (1968) that Ethiopian soils are rich in Potassium. The highest biological and economic optimum tuber yield was obtained from the application of Potassium (K) at 100 kg ha-1Therefore it is recommended that there is a need for verification and demonstration of K at 100 kg ha-1for potato production in Atsbi –Wenberta and other similar areas of Eastern Tigray, Ethiopia.

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