



Effects of Blended NPS Fertilizer and Composted Cattle Manure Rates on Potato (*Solanum tuberosum L.*) Production: A Review

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Abstract: *Potato (*Solanum tuberosum L.*) is one of the most popular and widely cultivated tuber vegetable crops in Ethiopia. It grows in short period, staple food and income source for small holder farmers. Potato cropping systems help to improve resilience especially among smallholder farmers by providing direct access to nutritious food, increasing household incomes and reducing their vulnerability to food price volatility. It is a high potential food security crop in Ethiopia due to its high yield potential, nutritional quality, short growing period and wider adaptability. The low actual yield of potato in Ethiopia is related to different factors, such as poor soil fertility, and sub-optimal fertilizer application rates are most determining factors. Soil fertility depletion owing to high rates of erosion is considered to be the fundamental bio-physical root cause for declining per capita food production in Africa, including Ethiopia in the fields of smallholders. Potato demands high levels of soil nutrients due to its relatively poorly developed, coarse, and shallow root system. The crop produces much more dry matter in a shorter life cycle that results in large amounts of nutrients removed per unit time, which generally most of the soils are not able to supply. Thus, In view of the above points, the main objective of this paper is to review on the optimum rate of NPS blended fertilizer and composted cattle manure on potato production.*

Keyword: *Potato, *Solanum tuberosum L.*, nutritious food, composted cattle manure, NPS blended fertilizer & potato production.*

1. Introduction

Potato (*Solanum tuberosum L.*) belongs to the family of Solanaceae and genus *Solanum* (Haward, 1969). It is the most important vegetable crop, constituting the fourth most important food crop in the world following wheat, maize and rice and first among root and tuber crops (Douches, 2013). Potato has its origin in the Andes of South America and was first cultivated in the Andes in the vicinity of Lake Titicaca near the present border of Peru and Bolivia (Horton, 1987).

More than a billion people consume potatoes and the total global potato production exceeds 374 million metric tons per year. Potato has been highly recommended by the Food and Agriculture

Organization as a food security crop. Potato cropping systems help to improve resilience especially among smallholder farmers by providing direct access to nutritious food, increasing household incomes and reducing their vulnerability to food price volatility (André *et al.*, 2014). Potato was introduced to Ethiopia in the 19th century by a German Botanist Schimper (Pankhrust, 1964). Since then, Potato has become an important garden crop in many parts of Ethiopia and it ranks first among root and tuber crops in volume produced and consumed followed by Cassava, Sweet potato and Yam (CSA, 2017). It is a high potential food security crop in Ethiopia due to its high yield potential, nutritional quality, short growing period and wider adaptability (Tewodros *et al.*, 2014).

Potato has been cultivated in Ethiopia for over 150 years and currently it is grown in many parts of the country. In meher season the production area for potato has reached about 66, 926ha with total yields of 921,403.2ton that cultivated by over 1.2 million households. On the other hand, the productivity of this crop in the country is very low (13.8 tha⁻¹) compared to the world's average yield of 19 tha⁻¹(CSA, 2017).

The low actual yield of potato in Ethiopia is related to different factors, such as poor soil fertility, and sub-optimal fertilizer application rates are most determining factors (Haverkort *et al.*, 2012). Soil fertility depletion owing to high rates of erosion is considered to be the fundamental biophysical root cause for declining per capita food production in Africa, including Ethiopia in the fields of smallholders (Tesfaye *et al.*, 2011). Potato demands high levels of soil nutrients due to its relatively poorly developed, coarse, and shallow root system (Dechasa *et al.*, 2003). The crop produces much more dry matter in a shorter life cycle that results in large amounts of nutrients removed per unit time, which generally most of the soils are not able to supply (Islam *et al.*, 2013).

Application of organic manure and inorganic fertilizers could substantially influence the yield of potato (Biruk *et al.*, 2015). Organic manures and their extracts have been reported to improve soil fertility, soil structure and furthermore help plants in combating pests and diseases (Khadem *et al.*, 2010).

Although mineral NPS fertilizers can be used to replenish soil nutrients and increase crop yields, concerns about soil exhaustion and nutritional imbalances, arising from increased and indiscriminate use of such fertilizers necessitate research on organic manure (Bayu *et al.*, 2006). However, the use of organic fertilizer alone may not fully satisfy crop nutrient demand due to low available nutrient, relatively low nutrient content, high application rates and high labour requirements unless it is integrated with inorganic fertilizers (Peter *et al.*, 2009).

In Ethiopia fertilizer determination research works carried earlier have been limited to the two common macronutrients i.e. N and P and hence the effects of blended fertilizers with cattle manure have not been studied. Balanced fertilization guarantees optimal crop production, better quality product and benefits growers and is also the best solution for minimizing the risk of nutrient imbalances. Nutrients such as N, P, S, and others can often be included in new fertilizer formula and use of balanced fertilizers in deficient soils can improve fertilizer-use efficiency and crop profitability (ATA, 2015).

Fertilizer use in Ethiopia has increased notably since 1990, but there is no concomitant attainable yield increase, especially in potato (Haverkort *et al.*, 2012). This is mainly due to use of the only two commonly known types of fertilizers i.e. DAP and Urea alone that may have resulted in unbalanced nutrient levels in the soil and use of specific area recommendation to wide areas (Chillot and Hassan, 2010). Cattle manure and other organic nutrient sources are important in maintaining soil fertility, improving crop yields and sustaining productivity when applied along with mineral fertilizers (Bayu *et al.*, 2006). Thus, In view of the above points, the main objective of this paper is to review on the optimum rate of NPS blended fertilizer and composted cattle manure on potato production.

2. Effects of blended NPS and Cattle manure on Potato Production

2.1. Production of Potato in Ethiopia

Potato, which was originated in the Andean mountain of South America and introduced to Europe in the 17th century, is today grown in North America and Europe is classified as *Solanum tuberosum L* (Spooner, 2010). The potato production area is rapidly expanding due to its high yield potential and

suitability hence, it is estimated that potato is cultivated at about one hundred thousand hectares of land each year (Endale and Gebremedhin, 2001).

Potato is one of the vital tuber crops that widely grown in the country with the highest rate of growth because of increasing demand and emerging markets, which in turn are providing great opportunity for resource poor farmers to generate additional income (Gebremedhin *et al.*, 2012). Potato is an important food and cash crop in Ethiopia and in high land areas particularly it plays tremendous role in ensuring food security for rural households involved in potato production in the region (Ermias, 2010).

According to CSA (2017), Potato is grown in three major seasons of Ethiopia under the belg (short rain season: February to May), meher (long rain season: June to October), and under irrigation, during dry season (October to January). Awi, South and North Gonder, East Gojjam and West Gojjam are the major potato producing zones in the Amhara National Regional State (Muhammad *et al.*, 2013). Oromia National Regional State is the second region with suitable agro-ecology for potato production in the country accounting for about 38.17% of the potato production in the country which it includes West Shewa, North Shewa and West Arsi zones are major producing zones (CSA, 2016). The Southern Nations, Nationalities and Peoples Region are the third major potato growing area accounting for about 16.62% of the potato production in the country. Gurage, Gamo-Goffa, Hadiya, Wolayita, Kambata-tembaro, Siltie and Sidama are the major potato producing zones of Southern Nations, Nationalities and Peoples Region (Gebremedhin *et al.*, 2012). In spite of such huge potential for high yield and quality of potato production, its productivity is very low (13.8 ton) compared to both African and world average tuber yield. Application of insufficient amount and type of fertilizer is one among the factors contributing for such low average tuber yield (Haverkort *et al.*, 2012).

2.2 Economic Importance of Potato

Potato is a very important food and cash crop in Ethiopia, especially in the highland and mid altitude areas (Hussain, 2016). Potato serves as food and cash crop for small scale farmers and occupies the largest area compared to other vegetable crops and produces more food per unit area and time compared to cereal crops (Tesfaye *et al.*, 2008). As a food crop, it has a great potential to supply high quality food within a relatively short period and is one of the cheapest sources of energy. Moreover, the protein from potato is of good composition with regard to essential amino acids in human nutrition (Hussain, 2016). The relatively high carbohydrate and low fat content of potato makes it an excellent energy source for human consumption. It is known to supply carbohydrate, high quality protein and a substantial amount of essential vitamins, minerals and trace elements (MoARD, 2011).

2.3 Ecological Requirements of Potato

Potato (*Solanum tuberosum L.*) is a weather sensitive crop with a wide variation among cultivars. It is a crop of temperate climate and it is moderately tolerant to frost (Rezaul Karim *et al.*, 2011). Potato grows well and produces yields at an altitude of over 1000 meters above sea level, although recently produced cultivars perform well at low elevations ranging from 400 to 2000 meters above sea level in tropical highlands (Levy and Veilleux, 2007). In Ethiopia, the altitude between 1800 to 2500 meters above sea level is regarded as suitable for seed and ware potatoes production (Bezabih and Mengistu, 2011).

Potato is grown in many different environments, but it is best adapted to temperate climates (Hijmans, 2003). Higher temperatures above 29°C diminish tuberization, promote foliage growth and reduce partitioning of photo-synthate and assimilate to the tubers (Levy and Veilleux, 2007). Potato is also frost sensitive and severe damage may occur when temperature drops below 0°C (Hijmans, 2003). Short day length and low temperatures are principally important to enhance tuber initiation and the number of tubers formed (Levy and Veilleux, 2007).

Potatoes can grow on organic and mineral soils, light soils with good aeration for the root system to maintain high tuber bulking rates (Gebre *et al.*, 2005) and soils with pH of 5.5 - 6.5 (Tantowijoyo and vande Fliert, 2006). Potatoes require high quantity of nutrients in order to form abundant vegetative mass and high quantity tubers per unit area (White *et al.*, 2007). Moreover, potatoes require high

amounts of fertilizer due to the characteristics of shallow and inefficient rooting system (Dechassa *et al.*, 2003).

Potatoes respond to an ample soil moisture supply with an increase in yield and quality (Dolores *et al.*, 2009). A rainfall ranging between 500 and 750 mm with even distribution during the growing period is generally necessary for optimum growth (Stol *et al.*, 1991). Potatoes have relatively shallow root zone and lower tolerance for water stress compared to other crops, therefore irrigation may be required where rainfall is limited (Makani *et al.*, 2013).

2.4. Effects of Mineral Nutrients on Growth and Yield of Potato

In the past years, mineral fertilizer was advocated for crop production to ameliorate low inherent fertility of soils in the tropics. However, currently it is well recognized that the use of mineral fertilizer has not been helpful in intensive agriculture because it is often associated with reduced crop yield, soil acidity and nutrient imbalance (Kumar *et al.*, 2013). However, appropriate mineral fertilizer application, especially nitrogen and phosphorus are required to correct the nutrient imbalance in infertile soils (Peter *et al.*, 2015).

2.4.1 Nitrogen

Nitrogen is a vitally important plant nutrient. In plant nutrition, N is an important constituent of all amino acids, chlorophyll, all proteins including enzymes and many other non-pertinacious compounds (Foth and Ellis, 1997). Nitrogen is very important nutrient in potato production as the value of the other inputs cannot be fully realized unless N is applied to the crop in an optimum amount (Ruža *et al.*, 2013).

The higher N rates are associated with more foliage, promoted photosynthetic action and translocation to tubers (Kumar *et al.*, 2007). However, an excess of this nutrient in relation to other nutrients, such as P, K, and S leads to excessive stolon and leaf growth, delayed leaf maturation, tuber differentiation, extended tuber bulking period, and ultimately reduced yield and tuber dry matter (Goffart *et al.*, 2008). Whereas shortage of N restricts the growth of all plant organs, roots, stems, leaves, flowers, stunted plant growth, yellowing leading to low fruits and seed yields (Barker and Bryson, 2007). Shortage of N also restricts tuber size due to reduced leaf area and early defoliation (Goffart *et al.*, 2008).

Several N fertilization rates have been advised as optimal rate for potato production. In some European countries and the USA that have a potato growth cycle of 4-5 months, the recommended N fertilization rates vary from 70-330kg ha⁻¹, and the most economically efficient rates range from 147-201kg ha⁻¹ (Fontes *et al.*, 2010). Researchers in the Czech Republic advice a fertilization rate of 140kg ha⁻¹ as the optimal to obtain tuber yield above 30 t ha⁻¹ (Ruža *et al.* 2013).

In Debre birhan, Ethiopia response of potato to different rates of N (0, 69, 138 and 207kg ha) was evaluated by (Zelalem *et al.* 2009). Results of this study showed that total tuber yield, total tuber number, and average tuber weight were increased by 119%, 34% and 82% relative to control, respectively due to the application of 207 kg N ha⁻¹. In Adet, (Lakachew 2007) found 16% more total yield increment at 23 kg N ha⁻¹ compared to the other treatments. In contrast, at Enderta, Southern Tigray, Frezgi (2007) obtained maximum total tuber yield (40.17 t ha⁻¹) at 150 kg N ha⁻¹, while minimum value (17.28 t ha⁻¹) was recorded at control.

Many factors and processes including initial amount of mineral N, net mineralization or immobilization, denitrification, leaching, and atmospheric deposition influence the relation between nitrogen supply and uptake (Ruža *et al.*, 2013).

Furthermore, according to Vos (1997), all factors that affect the depth of root penetration (density and texture of soil, pH, etc.) or its function (including pests, diseases, drought and water logging) also affect the relationships between supply and uptake. Potato is a crop that is highly responsive to N fertilizer (Sincik *et al.*, 2008).

2.4.2 Phosphorus

Phosphorus is the most important nutrient element after nitrogen, limiting agricultural production in most regions of the world (Kogbe and Adediran, 2003). It is known to be involved in several

physiological and biochemical processes of plants being components of membranes, chloroplasts, mitochondria (Sanchez, 2007) and constituent of sugar phosphate, such as adenosine diphosphate (ADP), adenosine triphosphate (ATP), nucleic acid, phospholipids and phosphate (Hue, 1995). In many soils plant available P is deficient and has to be supplemented with inorganic fertilizer and organic amendments (Osono and Takeda, 2005).

Potato is highly responsive to soil-applied nutrients, especially to phosphorus (P), due to its short life cycle and high yield potential (Fernandes and Soratto, 2012). Because the potato has an inherently low root density and restricted ability to recover fertilizer P (Dechassa *et al.*, 2003), and because of P is essential for plants, mainly for the metabolic processes related to energy uptake (Syers *et al.*, 2008), P deficiency can be a limiting factor to yield in commercial potato production (Fontes, 1997). Fontes (1997) further stated that plant growth is delayed at low P levels already in initial stages; besides, number and length of roots, stolon are as well as tuber yield reduced.

Leaf area index and other growth parameters of potato are positively related to P fertilizer application (Israel *et al.*, 2012). A study carried by (Ali and Anjum 2004) on the effects of P application on above ground growth and dry matter production of potato showed high leaf area index from the application of 400 kg P₂O₅ ha⁻¹; whereas high total plant dry matter from application of 50 kg P₂O₅ ha⁻¹. Results of experiment was conducted by (Balemi 2012) in a controlled growth chamber on the effect of P supply on morphological and physiological plant parameters of three potato genotypes grown under two P levels, such as 100 mg P kg⁻¹ soil (low P) and 700 mg P kg⁻¹ of soil (high P) at Ambo (Central Ethiopia). Results revealed that low P supply reduced shoot dry matter yield, relative growth rate, leaf number, total leaf area per plant, plant height and net assimilation rate of P-inefficient genotype more than that of the P-efficient genotypes.

Phosphorus is a nutrient that should therefore be available in adequate quantities from the early growth stages, to maintain a high photosynthetic rate during tuber bulking (McArthur and Knowles, 1993). However, the application of high P rates may cause environmental as well as economic damage in one hand and nutritional imbalance in potato plants on the other (Hopkins *et al.*, 2008).

In Manitoba, North America, Mohr and Tomasiewicz (2008) reported that total tuber yield increased linearly with increasing P fertilizer rate levels from 0, 34, 67, and 100 kg P₂O₅ ha⁻¹ with the lowest tuber yield than any other treatments being obtained from 34 kg P₂O₅ ha⁻¹. Similarly, Wijewardena (1996) recorded high yield of potato tuber (9.0 tha⁻¹) by applying 100 kg P ha⁻¹, which was followed by 6.6, 5.1, and 4.3 t ha⁻¹ by applying 50, 25, and 0 kg P ha⁻¹, respectively.

2.4.3. Sulfur

Sulfur is one of the essential nutrients for plant growth and it accumulates 0.2 to 0.5% in plant tissue on dry matter basis and is required in similar amount as that of P (Ali *et al.*, 2008). Sulfur has been found to be an indispensable element for crop production and it is an integral part of proteins, sulpholipids, enzymes (Das and Misra, 1991). Besides it is involved in various metabolic and enzymatic processes including photosynthesis and respiration (Rao *et al.*, 2001).

Its fertilization helps enhancing the uptake of N, and P in the plant. Due to its synergistic effect, the efficiency of these elements is enhanced which results in increased crop productivity. Sulfur application in potato showed significant influence on quality and yield. Highest tuber yield, large size and medium size tuber yield, dry matter content, specific gravity, sugar content and starch content were found with application of 45 kg ha⁻¹ sulfur (Sharma *et al.*, 2011).

2.5 Effects of Organic Manures on Growth and Yield of Potato

Organic fertilizers are all forms of organic soil amendments that originate from both livestock waste and crop residues, with the nutrients in them being mineralized by soil microbes and slowly making them available to plants over a long period of time (Lampkin, 2000). The application of organic manure can contribute to agricultural sustainability (Wells *et al.*, 2000) as continuous and adequate use of manure with proper management has been shown to have many advantages, which include providing a whole array of nutrients to soils, increasing soil organic matter (Verma *et al.*, 2005), improving water holding capacity and other physical properties of soil like bulk density, penetration resistance and soil aggregation (Wells *et al.*, 2000).

Since the nutrient content and the rate of nutrient release vary among organic fertilizers, the level of growth is affected either positively or negatively (Levy and Taylor, 2003). Comparison of effects of inorganic fertilizer with that of organic fertilizer sources on the growth of vegetables revealed that early growth was slower in organic fertilizer. This could be attributed to the lower levels of nutrients especially nitrogen and phosphorus in organic fertilizers available for plant growth (Xu *et al.*, 2003). Organic fertilizer releases various nutrients which are then converted from unavailable forms to available forms for plant growth with the help from soil microbes (Walker and Bernal, 2004). The authors further stated that microbes produce plant growth regulators important for plant growth and photosynthetic activity. That is why vegetables will grow better at a later growth stage and result in higher yields which can be attributed to high nutrient sustainability of organic fertilizer and improved biological properties of the soil (Levy and Taylor, 2003; Xu *et al.*, 2003).

Since potato production involves a high amount of soil tillage, and is particularly destructive to OM, management practices that add OM are particularly advantageous (Gasser *et al.*, 1995). In the last two decades, much research was devoted to comparing the effects of organic fertilizers, organic amendments and green manures and that of synthetic/mineral fertilizers on the tuber yields and tuber quality of potato (Alvarez *et al.*, 2006). Regular application of organic amendments can sustain soil N fertility and increase marketable potato yields by 2.5 to 16.4 t ha⁻¹, compared to the un-amended and unfertilized soil (Dayegamiye *et al.*, 2013). Canali *et al.* (2010) reported that application of FYM substantially increased the total potato yield by 25.1% as compared to control. Canali *et al.* (2012) reported that farmyard manure, green manures and compost applications might provide a valid alternative to the conventional mineral N fertilizers mitigating potential environmental risks due to N leaching and sustained potato yield. Mallory and Porter (2007) in a long-term experiment, found that soil management based on the addition of organic amendments enhanced potato yield, reducing year-to-year variability of those yields.

Nutrients contained in organic manures are released more slowly and are stored for a longer time in the soil, thereby ensuring a long residual effect supporting better root development, leading to higher crop yields (Abou-Hussein *et al.*, 2003). The benefits obtained from the use of organic materials have however not been fully utilized (Bayu *et al.*, 2006). Supply of nutrients from the organic materials can be complemented by enriching them with inorganic nutrients that will be released fast and utilized by crops to compensate for their late start in nutrient release (Ayoola and Makinde, 2009).

2.6 Integrated Nutrient Management in Potato

Integrated nutrient management implies the maintenance or adjustment of soil fertility and of plant nutrient supply to an optimum level for sustaining the desired crop productivity on one hand (Islam *et al.*, 2013) and to minimize nutrient losses to the environment on the other hand (Singhet *et al.*, 2002). It is achieved through efficient management of all nutrient sources (Singh *et al.*, 2008). According to these authors, sources of nutrients in the soil for a plant include soil minerals and decomposing soil organic matter, mineral and synthetic fertilizers, animal manures and composts, by products and wastes, plant residue, and biological N-fixation (BNF).

The main challenge in managing organic amendments for potato nutrition is to match N release with the crop N demand (Douglas and Magdoff, 1991). The potato crop requires much N in the early season, between 65 and 75 days after planting (Dayegamiye, 2009). The N availability from organic amendments may not be concomitant with the crop N demand period. Therefore, to meet crop N needs, organic amendments application has to be supplemented with N fertilizer although nitrogen surplus can occur when highly mineralize-able organic materials are applied at high rates and are combined with mineral N fertilizer. This may promote excessive vine growth, resulting in delayed tuber bulking and maturation, low specific gravity and higher levels of reducing sugars in tubers (Dayegamiye, 2009).

Table 1. Interaction effect of NPS Blended Fertilizer and Cattle manure on Growth & phonological variables of potato production.

No	NPS Blended fertilize (Kgha ⁻¹)	Cattle manure (t ha ⁻¹)	Plant height (cm)	Flowering	Physiolog ical Maturity
1	0	0	46.5	48.7	89.0
		10	56.7	51.0	90.0
		20	68.2	53.7	90.7
2	50	0	47.8	50.7	89.7
		10	57.6	51.7	91.0
		20	72.7	55.7	92.0
3	100	0	61.2	51.3	92.3
		10	83.9	57.3	94.3
		20	85.5	59.3	97.0

Source: Ababiya, (2018)

2.7 Response of Soil Fertility to Integrated Mineral NPS and Cattle Manure

Intensification of agriculture can have negative consequences such as increased erosion, reduced biodiversity and a reduction in soil organic matter content resulting in a decline in the quality of agricultural soils (Hosea *et al.*, 2012). The organic matter content of cultivated soils of the sub-tropics is comparatively low because of high temperature and intense microbial activity (Patra *et al.*, 2007). This requires application of external nutrients inputs via inorganic fertilizers and legumes, in combination with effective recycling of nutrients in production systems by means of proper handling and utilization of animal manure, leaving some portion of crop residues during harvest, biodegradable waste and green manure crops (Paul *et al.*, 2013).

For sustainable crop production, integrated use of inorganic and organic fertilizers has proved to be highly beneficial (Gruhn *et al.*, 2000). Integrated application of organic and mineral fertilizers helps to improve the physico-chemical properties as well as biological properties of soils (Swift *et al.*, 1994). Several researchers have demonstrated the beneficial effect of the combined use of chemical and organic fertilizers to mitigate the deficiency of many secondary and micronutrients in fields that continuously received only N, P and S fertilizers for a few years without any micronutrient or organic fertilizer (Hosea *et al.*, 2012). Dutta *et al.* (2003) reported that the use of organic fertilizers together with chemical fertilizers resulted in a higher positive effect on microbial biomass and hence soil organic matter compared to the addition of organic fertilizers alone.

According to Silva *et al.*(2004), cattle manure increased water retention and availability of phosphorus, potassium and sodium contents in the soil layer from 0-20 cm, but did not influence pH, calcium, sum of bases and organic matter contents.

The application of manure can contribute to agricultural sustainability. Kaur *et al.* (2005) reported that soils receiving FYM, poultry manure and sugarcane filter cake alone or in combination with chemical fertilizers improved the soil organic C, total N, P and S status and increased microbial biomass, C and N. Evaluations of integrated supply of FYM and mineral NPS fertilizers along with Sesbania green manuring for seven years on fertility build-up and nutrient uptake in a mint (*Mentha arvensis*) and mustard (*Brassica juncea*) cropping sequence indicated that integrated supply of organic and mineral fertilizers played a significant role in sustaining soil fertility and crop productivity (Chand *et al.*, 2006).

Many reports in the literature have showed that continuous use of sole artificial fertilizer nutrient sources may lead to shortage of nutrients not supplied by the chemical fertilizers which will in turn lead to chemical soil degradation (Mafongoya *et al.*, 2006). On the other hand, sole application of organic matter is constrained by low availability of N to the current crop, low or imbalanced nutrient content, unfavorable quality and high labor demands for transporting bulky materials (Palm *et al.*, 1997). The low P content of most organic materials indicates that in the long term addition of external sources of P will be needed to sustain crop productivity. The alternative is to combine application of organic matter and fertilizer so that improved crop yields are maintained without degrading soil fertility status (Swift

et al., 1994). Furthermore, to reduce the amounts of increasingly expensive inorganic P fertilizers, the combined application of P fertilizer and organic resources such as organic manure, crop residues, and other rural and urban organic wastes has frequently been suggested (Khan and Joergensen, 2012).

3. Summary and Conclusion

Potato (*Solanum tuberosum L.*) is one of the most popular and widely cultivated vegetable crops in Ethiopia. It grows in short period, staple food and income source for small holder farmers. Potato has been highly recommended by the Food and Agriculture Organization as a food security crop. Potato cropping systems help to improve resilience especially among smallholder farmers by providing direct access to nutritious food, increasing household incomes and reducing their vulnerability to food price volatility. It is a high potential food security crop in Ethiopia due to its high yield potential, nutritional quality, short growing period and wider adaptability.

Application of organic manure and inorganic fertilizers could substantially influence the yield of potato. Organic manures and their extracts have been reported to improve soil fertility, soil structure and furthermore help plants in combating pests and diseases. Although mineral NPS fertilizers can be used to replenish soil nutrients and increase crop yields.

As a general, both blended fertilizers and cattle manure has its own side effect on potato production. The following points are suggested as a future line of work in the current review area and other areas like:

- a. Assessment of the effect of combined application of blended NPS fertilizer and cattle manure using different varieties of potato at different location and season.
- b. Assessment of effect of different management practices on tuber quality
- c. Potato producers should be awarded, about the advantage of using blended NPS fertilizers and Cattle manure over using only in organic fertilizers for the society as a whole, and its effect on the production and productivity of potato.

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5. Conflict of Interest

Regarding the publication of this manuscript, there is no any conflict of interest.

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