

# Review on Production Status of Onion Seed Yield, Nutrient Uptake and Use Efficiency of Nitrogen and Phosphorus Fertilizations in Ethiopia

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**Abstract** – Onion is an important vegetable crop commercially grown both by large and small scale farmers in Ethiopia. Its production is constrained by a number of problems including declining soil fertility and inappropriate fertilizer application. The main aim of this review is to provide an overview of the onion seed productivity and its production of N and P fertilizer requirements like soil, climate and fertilization in general and specifically in Ethiopia, comparing them with current research trends and to indicate future benefits of soil nutrient investigations and their importance for agronomic and cultural practices. This paper reviewed that application of N and P mineral fertilizers under optimum nutrient availability in different soil types is an important crop mineral fertilizers strategy, which may help maximizing onion seed yield and quality. Lack of optimum nutrients and moisture in the soil has been the major problems of onion seed production and productivity in Ethiopia; since the onion has a very shallow and unbranched root system that requires frequent irrigation water and fertilization with different types of fertilizers under various soil types. Low soil fertility is one of the principal constraints to onion seed production in Ethiopia; thus, there are differences among soil types in yielding ability under different mineral nutrients and soil characteristics. Most smallholder farmers in Ethiopia appreciate the value of mineral fertilizers, but they are empty able to apply them at the recommended rates and at the appropriate time according to the soil characteristics. These are because of high cost, lack of knowledge, delivery delay and low income and variable returns. However, there was felt that could exist an opportunity to increase onion seed yields through selection of soil type and balanced nutrients application or searching for other nutrients sources beyond N and P especially in Ethiopian condition. Therefore, the use of inorganic N and P fertilizers inputs the best option to increase both yield potential and quality of onion seed yield production and environment-friendly sustainable farming systems and increase of profit margins for growers.

**Keywords** – Nutrient Uptake, Onion, Plant Growth, Seed Quality, Seed Yield, And Use Efficiency.

## I. INTRODUCTION

Onion (*Allium cepa* L.) belonging to the family *Alliaceae* is one of the most important vegetable crops commercially grown in the world. It probably originated from Central Asia between Turkmenistan and Afghanistan where some of its relatives still grow in the wild. Onion from Central Asia, the supposed onion ancestor had probably migrated to the Near East and areas around the Mediterranean Sea are secondary centers of development [1] [2] [3].

Onion is currently becoming a popular vegetable crop despite to its recent introduction to the country because of its yield potential per unit areas, the ease of propagation method both by seed and bulb method, and the presence of high domestic and export markets [4] [5] [6] [7]. Onion is more widely grown in Ethiopia for local consumption and for flower export. It contributes significant nutritional values to the human diet and has medicinal properties and is primary consumed for its unique flavors or for its ability to enhance the flavors of other foods [4].

In Ethiopia, at present different vegetable crops are produced in many home gardens and also commercially in

different parts of the country [8]. Among these vegetables, onion is one of the most important cash crops. Onion production also contributes to commercialization of the rural economy and creates many off-farm jobs [4] [9].

Onion seeds are well known to be highly perishable and poor in keeping quality and lose viability within a year. One of the problems of onion production in the tropics is lack of seed which is true to type with high germination and vigor [10] [11]. Onion seed is usually produced in the temperate and subtropical countries. In the countries where high temperature prevails throughout the year, only the easy-bolting types of onion, requiring relatively low-temperature exposure, can produce seed [12].

During the 2017/2018 production year, the Oromia Region's onion production coverage was estimated about 13,669.5 ha<sup>-1</sup> from which 1,033,485.45 tons of onion bulbs was produced with an average yield of 7.56 tons ha<sup>-1</sup>. Ethiopia is one of the potential areas for vegetable production especially onion. Different onion varieties are widely produced by the farmers in Ethiopia. In many parts of the country, the off season crop (under irrigation) constitutes much of the areas under onion production [13].

The price of onion botanical seed remains high in the season of onion cultivation. Seed is the basic and essential input for any crop production [14]. Seed production is a vital part in onion growing and is highly specialized business [15]. The yield of onion seed in our country varies from 1000 - 1300 kg ha<sup>-1</sup> [16], 116.32 - 118.2 kg ha<sup>-1</sup> [17], 75.15 - 1155.75 kg ha<sup>-1</sup> [18] and 748.9 - 879.4 kg ha<sup>-1</sup> [19] which is very low compared to the average seed yield in some other countries of the world, 600 - 2000 kg ha<sup>-1</sup> [20] and 828 - 1446 kg ha<sup>-1</sup> [21].

Nutrients play a significant role in improving productivity and quality of vegetable crops. Therefore, increasing the productivity of onion with a good quality is an important target for producers. Onions are the most weak crop plants in extracting nutrients, especially the immobile types, because of their shallow and unbranched root system; hence they require and often respond well to addition of fertilizers. Therefore, optimum fertilizer application and cultivation of suitable varieties with appropriate agronomic practices in specific environment are necessary for obtaining good yield of onion [22].

Nitrogen (N) and phosphorus (P) are often referred to as the primary macronutrients because of the large quantities taken up by plants from the soil relative to other essential nutrients [23]. Nitrogen comprises (1-5%) of total dry matter of plants and is a constituent of many fundamental cell components [24]. Phosphorus is making up about 0.2% of a plant's dry weight and it is essential for root development. Plants must have phosphorus for normal growth and maturity (Fairhurst *et al.* 1999).

According to [25] P deficiency is one of the largest constraints to crop production in many tropical soils, owing to low native content and high P fixation capacity of the soil. When the availability is limited, plant growth is usually reduced. In soils that are moderately low in P, onion growth and yield of onion seed can be enhanced by applied P. Quality of onion seed can be affected by mineral nutrition, irrigation schedule or rainfall [4]. Fertilizer practices for the onion seed crop vary widely. In Ethiopia 90-135 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> and 81-144 kg N ha<sup>-1</sup> urea is used for bulb production in sandy loam soil while 92 kg N ha<sup>-1</sup> is used for seed production [4] [5] [17] [26].

Reports indicated that the low yield of onion seed in the country is due to low fertility of soil, inappropriate fertilizer use, lack of improved varieties, and poor management practices [4]. Among these constraints, inappropriate use of mineral fertilizer was one of the most important management factors in Ethiopia. The

objective of this review was application of appropriate rate and types of fertilizers are vital operations for high seed yield and quality of onions.

### 1.1. *Description of Onion Crop and Distribution*

Onion belongs to the genus *Allium* of the family *Alliaceae* and is one of the oldest cultivated vegetable, for over 4000 years [27]. It is probably originated in central Asia between Turkmenistan and Afghanistan where some of its relatives still grow as wild plants [28]. From central Asia, the supposed onion ancestor had probably migrated to the Near East. Then it was introduced to India and South-East Asia; and into the Mediterranean area and from there to all the Roman Empire [2].

Onion is an herbaceous biennial monocot cultivated as an annual. Onion being a biennial crop, takes two seasons for seed production. During the first season bulbs are formed while flower stalks and seeds are developed in the second season. Onion is grown mainly for their bulbs, although the green shoots of salad. Onions are usually grown from seed, and flowering and seed production are important for crop production [29].

### 1.2. *Onion Production Status in the World*

Onions are the second most valuable vegetables in the world, following tomato. The production of onion crop is worldwide because of its wide benefits in our daily foods requirements. Onion is largely produced in the developed nations and has dominated in the international markets due to its higher quality production and longer storage life [30]. It is estimated that around the World, over 3,642,000 ha of onions are grown annually. On a worldwide scale, around 80 million metric tons of onions are produced per year. China is by far the top onion producing country in the world, accounting for approximately 28% of the world's onion production, followed by India, USA, Iran, Egypt, Turkey, Russia, Pakistan, Netherlands and Brazil. The world wide onion exports are estimated at around 7 million Metric tons. The Netherlands is the world's largest onion exporter with a total of around 220,000 Metric tons followed at a distance by India [15]. In Africa, Egypt is the leading country by producing 22.08 million tons of onion per year for domestic and international markets that rank as the fourth of world producer [31].

### 1.3. *Importance and Production Status of Onion in Ethiopia*

Onion is a high-value bulb crop that has produced by smallholder farmers and commercial growers for both local and export markets in Ethiopia [32]. Onion is considered as one of the most important vegetable crops produced on large scale in Ethiopia. It also occupies an economically important place among vegetables in the country. The area under onion is increasing from time to time mainly due to its high profitability per unit area and ease of production, and the increases in small scale irrigation areas [9]. The major production is in the Rift Valley areas. Besides bulb production, there is a great potential for seed production in these areas. Onion production in the country is increasing from time to time [4]. During the 2017/2018 cropping season, the total area under onion production was estimated to be 33, 603.39 ha<sup>-1</sup> with an average yield of about 9.8 t ha<sup>-1</sup> and estimated a total production of greater than 3, 274, 7525.4 tons [13].

### 1.4. *Climate and Soil Requirements of Onion*

Onion is a cool season crop plant that has some frost tolerance, but is best adapted to a temperature range between 13 and 24°C. Optimum temperatures for early seedling growth are between 23 and 27°C; growth is

slowed at temperatures above 30°C. Acclimated plants are able to tolerate some freezing temperature [33]. In Ethiopia onion can grow between 500 and 2400 m.a.s.l, but the best growing altitude so far known is between 700 and 1800 m.a.s.l [4]. Onion roots are shallow and coarse and most of the roots occur within 15- 20 cm of the surface, and seldom extends horizontally beyond 50 cm. Onion roots are short lived, being continuously produced, rarely have branch and root hairs and rarely increase in diameter. Onion can be grown in all types of soils; sandy, heavy clay, peat organic soils or volcanic soils. However, for higher yield drained friable loam soils with a pH of 6.0-6.8 are ideal. Onion does not thrive in soils of pH below 6.0 because of trace elements deficiencies or, occasionally, aluminum or manganese toxicity [34].

### 1.5. Flower Development and Seed Formation

Bolting, or inflorescence production, can occur in all the vegetable *Alliums* and the process is similar in all. The inflorescence develops from the shoot apical meristem under appropriate environmental conditions. In onion there were commonly 200 to 600 flowers per umbel, depending on cultivar, growing conditions and whether the umbel is formed from the main growing point or an axillary shoot. Similar umbels containing large numbers of flowers are produced by leeks and Japanese bunching onions [35].

In India the time required to reach 50% flowering ranged from 82.5 to 88.25 days from planting. The earliness in flower development had significant effect on the diameter of the umbels. The earliest umbel had the maximum diameter of 7.2 cm as compared to the late flowering umbel measuring 6.68 cm in diameter. This could be probably because of the fact that early flowering umbels benefit from maximum assimilates partitioning and better dry matter accumulation for seed set. Thousand seed weight was affected significantly by temperature and cultivars and ranged from 2.5 to 5.1g whereas germination percentages ranged from 76.2 to 87% [36].

The onion seed can be produced either by bulb to seed method or seed to seed method of production systems. The bulb to seed method of production system has the advantage of maintaining the seed quality of onion by rouging of the off-color, miss shaped, split and rotten types whereas the seed to seed type can be used alternatively to speed up the production practices without affecting the varietal quality [9].

### 1.6. Seed Production Potential of Onion

Seed production is one of the most important and potential area in onion production that can bring a high economic benefit for small scale farmers. Most tropical countries near the equator import much of their onion seeds because temperature is not cool enough to induce optimal flowering. However, there is also possibility of producing onion seed using artificial Vernalization [37]. In Kenya, research conducted on three local and eight introduced onion cultivars showed that bulbs stored at 10°C flowered earlier than those stored at other temperatures and those stored at 21.9°C were the latest to flower [37]. In Ethiopia, temperature of 9-17°C was indicated to be favorable for flower stalk development and seed production [38].

### 1.7. Factors Affecting Seed Quality and Quantity of Onion

The productivity of onion seed is much lower than other African countries of Ethiopia. For the supply of such seeds, the informal sector is playing significant role in outreaching large number of farmers. Most of the demand for onion seed is either met by private sectors or unorganized program and imported seeds. The formal sector,

Ethiopian Seed Enterprise (ESE) is not generally supplying onion seed. Limited amount is catered by public sector organizations like Ethiopian Institute of Agricultural Research (EIAR) as popularization activities [9]. One of the major onion production problems is lack of high quality seeds and improper agronomic practices used by farmers such as fertilizers [39]. The main seed supply is from unreliable sources, where after number of market picks the late fruits or part of the crop is kept for seeds. Such seeds are usually of low quality (viability, vigor and genetic purity). However, they are kept for the next season and the surplus is sold to neighbor farmers [40].

Factors affecting seed quality before harvest may have further impact. For example they might increase seed deterioration rate during storage. In general, longer seed storage life is obtained if seeds are kept dry and at low temperatures. Many vegetable seeds will maintain germination rates of at least 50% for ten or more years. However, the relative longevity of onion seeds under cool and dry conditions is 1-2 years [41]. Seed germination and vigor are the main seed physiological quality attributes affected during seed deterioration. Planting season can also affect onion seed production [40].

### 1.8. *Components of Onion Seed Yield*

The most important components for onion seed production are umbel size, flower stalk height, number of flower stalks per plant and flower stalk diameter, which are closely related with the size of mother bulb and cultivars [42]. The number of flower stalks per plant varied from 1 to 15 per plant at Melkassa and the terminal number of 50-200 flowers produced per umbel on depending on the number of shoots axis [38].

In India, seed yield per plant was positively and significantly correlated with the number of seed stalk per plant and seed yield per umbel. Umbel diameter was the most important index for seed yield. This character was influenced strongly by base flower stalk diameter. While cause and effect relationship between seed weight and the evaluated components in the inflorescence, it was found that umbel diameter was determining seed yield. This indicated that this character could be a good index for seed yield estimation in onion. The number of flower stalks per plant varied from 3-15 with umbel diameter differences of 5-10 cm. The range of flower stalk height was from 76-115 cm; the highest seed yield among the cultivars was correlated with seed stalks number per plant and umbel diameter. The variation in yield among the cultivars was caused by the large difference in number of umbels per plant and number of productive florets per umbel [42] [43].

### 1.9. *Nitrogen in Soils and its Availability to Plants*

Nitrogen being the most often growth limiting nutrient is found to be an essential constituent of metabolically active compounds such as amino acids, proteins, co-enzymes and some non-pertinacious ones [44]. Nitrogen comprises 7% of total dry matter of plants and is a constituent of many fundamental cell components [24]. Nitrogen constitutes about 5 to 6% of soil organic matter by weight and it is added to the soil both in symbiotic and non-symbiotic forms from the atmosphere. Hence, it plays a vital role in all living tissues of the plant. No other element has such an effect on promoting vigorous plant growth as has N. Abundant protein tends to increase the size of the leaves, and accordingly, brings about an increase in carbohydrate synthesis [45].

Plant roots take up nitrogen from the soil solution principally as nitrates  $\text{NO}_3^-$  and  $\text{NH}_4^+$  ions. Although certain plants grow best when provided mainly one or the other forms, a relatively equal mixture of the two ions gives the best results with most plants. Nitrate is the preferred form of N for uptake by most plants, and it

usually is the most abundant form that can be taken up in well-aerated soils. The quantities of  $\text{NO}_3^-$  found in soil at any time, however, usually represent only enough N to support uptake for a short period. Nitrate anions move easily to the root with the flow of soil water and exchange at the root surface with  $\text{HCO}_3^-$  or  $\text{OH}^-$  ions that, in turn, stimulate an increase in the pH of the soil solution immediately around the root. In contrast, ammonium cations exchange at the root surface with hydrogen ions, thereby lowering the pH of the solution around the roots [46]. Onion also takes up nitrates in much greater amount than ammonium [47].

#### 1.10. *Role of Nitrogen in Onion Crop*

Plant tissues usually contain more N than any other nutrient normally applied as a fertilizer. Nitrogen is an integral component of many essential plant compounds. This nitrogen is needed to form chlorophyll, proteins and it is a major part of all amino acids and many other molecules essential for plant growth and other critical nitrogenous plant components such as the nucleic acids and chlorophyll [46]. Nitrogen in the plant controls the utilization of phosphorus and potassium and excess could delay maturity by causing too much vegetative growth [48]. Increasing nitrogen levels from 0 to 120 kg ha<sup>-1</sup> resulted in progressive increase in seed yield of onion. Nitrogen is also essential for carbohydrate use within plants [49]. A good supply of nitrogen stimulates root growth and development as well as the uptake of other nutrients [46].

#### 1.11. *Response of Onion to Nitrogen Fertilization*

Onion is a heavy feeder, requiring ample supplies of nitrogen. Too much N can result in excessive vegetative growth, delayed maturity, increased susceptibility to diseases, reduced dry matter contents and storability and thus result in reduced yield and quality of onion seed [34] [50]. Bolting is triggered in response to exposure of the onion plant to conditions like low temperature or limited N supply which induces flowers to emerge before bulb are adequately grown to suppress flower initiation [51]. The highest percentage of bolting was obtained from plants fertilized with the lowest level of nitrogen (100 kg N ha<sup>-1</sup>) [52]. Nitrogen fertilization significantly reduced bolting in onion. The authors reported that ratio of bolting percentage per plot decreased by about 11 and 22% in response to the fertilization of 69 and 92 kg N ha<sup>-1</sup>, respectively as compared to the control. Nitrogen fertilization significantly extended the number of days required for onion crop to attain its physiological maturity [26]. The delay in maturity of onion bulb due to application of enhanced level of nitrogen. Generally, considering the status of the soil, additional nitrogen fertilizer levels application may be necessary in order to meet the crop N requirements [53].

#### 1.12. *Phosphorus in Soils and its Availability to Plants*

Phosphorus has by far the smallest quantities in solution or in readily soluble forms in mineral soils compared with all other macronutrients found in soils, generally ranging from 0.001 mg/L in rich, heavily fertilized soils. Plant roots absorb phosphorus dissolved in the soil solution, mainly as phosphate ions ( $\text{HPO}_4^{2-}$  and  $\text{H}_2\text{PO}_4^-$ ), but some soluble organic phosphorus compounds are also taken up. The chemical species of phosphorus present in the soil solution is determined by the solution pH. In strongly acid soils (pH 4.0 to 5.5), the monovalent anion  $\text{H}_2\text{PO}_4^-$  dominates and is slightly more available to plants than the divalent anion  $\text{HPO}_4^{2-}$  which characterize alkaline solutions [54]. Phosphorus is an immobile nutrient and continued application of phosphate fertilizers tends in time to increase the levels of this nutrient in the soil and particularly its level in the liable forms that can release phosphorus to the soil solution [55]. By holding the pH of soils between 6 and 7, the phosphate fixation

can be kept at a minimum. Due to the general immobility of phosphorus in the soil profile, fertilizer placement is generally more critical for P than N. Phosphate fertilizers are commonly placed in localized bands to prevent rapid reaction with the soil [54].

Most of the P present in soils is in unavailable forms and added soluble forms of P are quickly fixed by many soils [56]. In most soils, the amount of P in the available form at any one time is very low, seldom exceeding about 0.01% of the total P in the soil. Thus, available P levels must be supplemented in most soils by adding chemical fertilizers. Unfortunately, much of added P is converted to the less available secondary mineral forms. These secondary forms are released very slowly and become useful to plants only over a period of years [46].

### 1.13. Roles of Phosphorus in Plant Nutrition

Phosphorus as an important nutritional element plays and its part in regulates many physiological criteria in the plant which in turn affect the total yield. One fact must be put in mind is that, the provided P to the plant or the soil depends largely on the available reservation of this element in the soil, so the negative or the positive results may be due to sources stored in the soil. The presence of phosphorus in the soil encourages plant growth because phosphorus is an essential nutrient. Practically, P is a major building block of DNA molecules [57].

Phosphorus is an essential component of deoxyribonucleic acid (DNA), the seat of genetic inheritance and of ribonucleic acid (RNA), which directs protein synthesis in both plants and animals. Phospholipids, which play critical roles in cellular membranes, are another class of universally important phosphorus-containing compounds. For most plant species, the total phosphorus content of healthy leaf tissue is not high, usually comprising only 0.2 and 0.4% of the dry matter [46]. In addition, reported that the two forms of P in soil are organic and inorganic. Organic P is the most stable form of P in the soil than inorganic P. Therefore, inorganic P is readily absorbed and used by plant if it is not fixed. Organic P is mineralized and immobilized by microbes' activities. Mineralization is the conversion of organic P to inorganic P, whereas, the immobilization of P involves the formation of organic P from inorganic P [58].

Phosphorus is essential for numerous metabolic processes. Among the significant function and qualities of plants on which phosphorus has an important effects are enhances many aspects of plant physiology, including the fundamental processes of photosynthesis, reproduction, nitrogen fixation, flowering, fruiting (including seed production) and maturation. Root growth, particularly development of lateral roots and fibrous rootlets is encouraged by phosphorus. In cereal crops, good phosphorus nutrition strengthens structural tissues such as those found in straw or stalks, thus helping to prevent lodging (falling over). Improvement of crop quality, especially in forages and vegetables, is another benefit attributed to this nutrient [46].

### 1.14. Phosphorus Requirement of Onion Seed Production

In onions, phosphorus deficiencies reduce root and leaf growth, bulb size, and yield and can also delay maturation [59]. In soils that are moderately low in phosphorus, onion growth and yield can be enhanced by applied phosphorus. Results of long-term fertilizer trials on loamy sand soils in Germany have shown a strong response of onions to phosphorus fertilization in the range 0 to 52 kg ha<sup>-1</sup> phosphorus [60]. Who reported that at 45 days after planting of onion, different phosphorus levels resulted in significantly different plant heights where the tallest plants were observed at higher rates of applied phosphorus while the shortest plants were from the control plots.

### 1.15. *Effect of Nitrogen and Phosphorous Fertilization on Seed Yield and Quality*

Fertilizer practices for the onion seed crop vary widely. According to [62] application of different doses of macronutrients increased number of umbels per plot, number of seeds per umbel, weight of seeds per umbel, seed yield per plant and per hectare. The maximum number of seeds per umbel, weight of seed, seed yield per plant and seed yield per hectare was found from 114 N and 42 P kg ha<sup>-1</sup> treatment and the minimum number of seeds per umbel, weight of seed, seed yield per plant and seed yield per hectare was found from 57 N and 21 P kg ha<sup>-1</sup> treatment respectively. According to [63] the result indicated that nitrogen fertilization significantly increased the length of leaves, number of leaves, length of flowering stalk and number of flowers per umbel. The highest records for the four growth parameters were obtained by 90 kg N fertilization.

According to [64] who reported days to bolting, days to 50% flowering, days to maturity, flower stalk diameter, numbers of umbels per plant, umbel diameter, and number of seeds per umbel and seed weight per umbel were significantly affected by the main effect of NP fertilizer rates.

According to [65] experiments conducted on 26 multilevel N-fertilizer trials in the Netherlands showed that application rates ranging from 72 to 110 kg ha<sup>-1</sup> could be applied as two or three split dressings, but the work did not change existing recommendation of a fixed rate of 100-120 kg N ha<sup>-1</sup>. Adequate nitrogen fertilization is essential for good quality and yield of onion production. Reported that good seed yield up to 1000 kg ha<sup>-1</sup> is produced from a range of nitrogen fertilizer levels from 0 to 150 kg ha<sup>-1</sup> with 30 kg ha<sup>-1</sup> increments [66]. Confirmed on their study that seed yield has been increased in response to the increase in nitrogen level in accordance with the increase of seed yield of individual plants [67].

Reported that nitrogen fertilization had significant impact on seed yield of onion [68]. The report claimed that there is an increase on seed yield per umbel, per plot and per hectare. The highest yield was recorded on 150 kg ha<sup>-1</sup> nitrogen treated bulbs while the lowest yield was recorded on control plots. Percent seed germination increased with an increase of nitrogen fertilization from control. The highest percentage was at 150 kg ha<sup>-1</sup> N but farther increase in the dose of fertilizer did not increase the percent germination.

According to [17] reported that phosphorus fertilization at 46 kg ha<sup>-1</sup> P<sub>2</sub>O<sub>5</sub> showed significant effect on umbel diameter, number of umbels per plant, number of seeds per umbel, seed yield per plant, seed germination at harvest. On the other hand, nitrogen fertilization at 138 kg ha<sup>-1</sup> showed highly significant effect on flower stalk diameter, number of umbels per plant, number and weight of seeds per umbel and on seed yield per plant.

Phosphorous fertilization has also great impact on seed yield and quality of onion. According to the report of [61], phosphorous fertilization increased seed yield per umbel, per plot and per hectare. Fertilizer rate of 80 kg ha<sup>-1</sup> significantly increased the seed yield as compared to the control. On the other hand the weight of 1000 seed of onion did not show significant difference between fertilized and unfertilized seeds. But the percent germination showed great improvement with an increase of phosphorous fertilization.

According to [69] nitrogen application had significantly increased the seed yield as well as quality, but phosphorous fertilization which was done in absence of nitrogen fertilization did not show significant effect. However, they got highly significant response when phosphorous was applied in combination with nitrogen fertilization. The experiments conducted over two successive seasons showed that nitrogen application had significantly increased plant height, flower stalk thickness and seed yield. But phosphorus fertilization in the

absence of nitrogen had no significant effect on seed yield. However, a highly significant increase in seed yield was obtained when phosphorus was used in combination with nitrogen.

According to [19] the result showed that the highest seed yield and yield components and seed quality attributes were obtained from 115 P<sub>2</sub>O<sub>5</sub> and 114 N kg ha<sup>-1</sup> combination followed by 143.6 P<sub>2</sub>O<sub>5</sub> and 142.5 kg N ha<sup>-1</sup>. The results showed that the main effect of NP fertilizers and plant spacing were highly significant on flower stalk diameter, seed yield per plot and per hectare, number of seeds per umbel and significantly affected plant height and seed weight per umbel. However, NP fertilizer alone was significant on days to bolting, umbel diameter and 1000 seed weight.

The application of nitrogen fertilizer appreciably increased seed yield per plant and umbel number per plant in Sudan. This increment in seed yield was a result of reduced flower abortion [70]. Fertilizer trial on onion in a semiarid tropical soil of Nigeria showed that N and P and their interaction increased number of umbels per original bulb, seed weight per umbel and seed yield. At 50 kg P ha<sup>-1</sup>, the application of 50 or 100 kg N ha<sup>-1</sup> gave significantly higher seed yield than other N and P rate combinations tested [71].

The results showed that plant height, tillers, flowers, seeded fruit, fruit set, and days to blooming, seed yield and germination percentage were significantly influenced by different treatments. The yield of seed increased with increased levels of different treatment combination. The treatment combination at a level NK (150-120 kg ha<sup>-1</sup>) produced the maximum yield of seed per hectare (515.42 kg ha<sup>-1</sup>) followed by 100 kg N ha<sup>-1</sup> with 120 kg ha<sup>-1</sup>, 150 kg N ha<sup>-1</sup> with 40, 80 kg K ha<sup>-1</sup> respectively. He concluded that nitrogen 150 kg ha<sup>-1</sup> with potassium 80-120 kg ha<sup>-1</sup> produced more effective flowering stalks and showed better performance on seed yield and quality of onion [72].

#### 1.16. *Nutrient Uptake, Concentration and Use Efficiency of Onions*

Response of crops to fertilizer, which is a function of nutrient uptake, is highly variable and depends on crop, type of soil, past use of the land, local weather condition as well as the choices of the whole season. Nitrogen fertilizer application improves phosphorus uptake from the soil [73] [74].

The nutrient requirement of the crop can be met by nutrient available in the soil and by nutrient additions. When fertilizer prices represent a large portion of a producer's costs, it is very important to maximize fertilizer use efficiency [75]. According to [76] the nutrient content of plant tissue reflects soil availability. The amounts of nutrients exploited in the harvest portion of the crop will depend on the yield and the concentration of the nutrients in the time and space, variety, soil and environmental factors [73] [74].

The amount of N needed is usually based on soil organic matter content, crop uptake and yield levels. Nitrogen uptake levels by onion crops may vary from less than 50 kg to more than 300 kg ha<sup>-1</sup>, depending on cultivar, climate, plant density, fertilization and yield levels [77]. The movement of phosphorus in soils is very low and its uptake generally depends on the concentration gradient and diffusion in the soil near roots [78]. Depending on yield levels, phosphorus uptake rates in onion are estimated to be 15-30 kg ha<sup>-1</sup> [79].

Fertilizer use efficiency depends to large extent on soil fertility conditions. To use fertilizers in a sustainable manner, management practices must aim at maximizing the amount of nutrients that are taken up by the crop and minimizing the amount of nutrients that are lost from the soil. Improving agronomic efficiency provides both direct and indirect economic benefits: larger yield increases can be achieved for a given quantity of

fertilizer applied; or less fertilizer is required to achieve a particular yield target [80]. N fertilizer use efficiency (NFUE) by onion to be about 15% [81]. [82] also reported the need for high rates of N on onion to optimize yield in New Mexico, but expressed concern about leaching of  $\text{NO}_3^-$  N from the root zone and the low NFUE (30%) by onion. Application of the highest level of nitrogen and P fertilizers (150 kg N and 100 kg P) produced the highest values of yield, quality and nutrients uptake (279.3 and 262.2 mg plant<sup>-1</sup>) characters of onion respectively and the lowest was recorded from control [83].

## II. CONCLUSION AND RECOMMENDATION

Onion is one of the most important vegetable crops commercially grown both by large and small scale farmers in Ethiopia. It is a high value and high income generating vegetable crops for most farmers in Ethiopia, which is widely produced in small scales and by commercial growers and considerably important in the daily meal of Ethiopians. Onion is one of the most important income generation crops both cultivated under rained and irrigation in Ethiopia.

The enhancement of onion production and productivity can be constrained different growth factors. Thus, the use of appropriate agronomic management has an undoubted contribution to increased crop yields. There are a number of constraints that cause low productivity of onion seed production in Ethiopia. The low yield of onion seed in the country is due to low fertility of soil, inappropriate fertilizer rate, lack of improved varieties, and poor management practices.

Also the productivity and area of most of the crops grown in many parts of Ethiopia are declining due to soil degradation and the constraints of moisture and nutrients unavailability accompanying it and other poor cultivation practices. However, farmers continue growing onion seeds in spite of obtaining low yields as a result of having little choices as producing the crops are vital for meeting their economic needs. Generally, nitrogen and phosphorus fertilizer application would be preferred for onion seed production is valuable to the plants for higher yield potential, seed quality and environment-friendly sustainable farming systems and increase of profit margins for growers for Ethiopian.

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