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Review on: Effect of different nitrogen rate on the growth and yield of cabbage (*Brassica oleracea var L.*)

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Abstract

Cabbage (*Brassica oleracea var L.*) is also known as cool vegetable crops. It is one of the most popular and widely growth vegetable crops in the world. It contains a range of essential vitamins and minerals as well as small amount of protein and good caloric value. Cabbage is an excellent source of mineral such as calcium, iron, sodium, Potassium and phosphorus. In our country has a variety of vegetable crops grown in different agro-ecological zones by small farmers, mainly as a source of income and food. Cabbage can be grown at any time of the year but better quality and greater yields can be obtained during warmer months of the year. Cabbage has been domesticated and used for human consumption since the earliest antiquity. It is only head cabbage that changes in leaf shape becoming wider because of the shorter petiole length with increasing leaf position and thus cabbage acquired the developmental change in leaves. Nitrogen is a constituent of all living things a synthesis and transfer of energy. Nitrogen rate has a significant effect on leaf length of cabbage. Similarly leaf width of cabbage had significant difference between different rates of nitrogen. Nitrogen is vital for the leaf growth of cabbages to begin.

Keywords: Cabbage, nitrogen, growth and yield

1. Introduction

1.1 Background and Justification

Cabbage (*Brassica oleraceavar. L.*) belongs to the family Brassicaase and it is biennial crop with a very short stem supporting a mass of overlapping leaves to form a compact head. It originated from wild non-headed type colewort from Western Europe and northern shore of Mediterranean. It has been domesticated and used for human consumption since the earliest antiquity. It is cool season crop that is popular with gardeners and commercial producers (Muzmil, 2012). Cabbage is known for its nutritional importance and it is rich in mineral and vitamins like A, B1, B2, and C. It is also know an appetizer, it aides digestion thereby help preventing constipation. It also protects against cancers (Muzmal *et al.*, 2011) ^[13]. Cabbage can grow easily under wide range of environmental condition in both temperate and tropical, but cool moist climate is most suitable (Muzimal *et al.*, 2011) ^[13].

Cabbage is grown for its head in more than ninety countries throughout the world (Meena, *et al.*, 2010) ^[10]. The major cabbage growing countries of the world are china, India, South Korea, Germany, Japan and South Africa (Muzimal *et al.*, 2018). The area planted with headed cabbage worldwide in 2009 was estimated at about 3.2 million hectare in 124 countries production some 71 million tones. In the same year, area planted by cabbage was about 2.5 million hectare in Asia, 0.5 million hectare in Europe, 80,000 hectare in America and 120,000 hectare in Africa (Nina, 2011). In Africa a total of 2 million tons were produced in 2008 and it has shown an increase by 20% over the 10-year period between 1998 and 2008.

Area, production and yield of head cabbage in Ethiopia 2007/2008 were 1989 hectares, 11,765 tons and 5.9 t/ha respectively. In 2008/2009 it grew to 3399 hectares, 24, 133, 4 tons and 7 t/ha respectively. Within these two years the area has increased by 70% whereas the production has increased by 105%. In Oromia Regional state the area covered by head in year 2008/2009 was 2188.9 hectares while the production was 15,601.9 ton and the yield is 7 t/ha (CSA, 2017) ^[6].

In general crop production can be increased either by improving inherent genetic potential of the crop or through application of better agronomic management such as fertilizer rate which contribute to substantial amount of crop (Frezer, 2007) ^[8]. The possibility of securing high yield depends much upon a proper consideration of optimum nitrogen rate per unit area and the

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Pattern in which the given quantity of seeds or plant population is arranged in the field of planting (Banchalem Adisu 2010) This is due to the fact that the quantity of solar radiation, which penetrates a crop canopy greatly, depends on nitrogen rate and individual plant morphology (Banchalem, *et al.*, 2010).

Likewise the plant density, low soil fertility also considered as serious problems among several production limiting factors in the study area. Nitrogen in one of the critical plant nutrients in cabbage yield and it is significant to note that nitrogen fertilizer (response is directly associated to the soil type, emphasizing that soil varying in fertility status react differentially to the applied (Frezer 2007) [8]. Nitrogen fertilizer which is relatively more important for vegetative part development could be the best alternative. And investigating the optimum rate of nitrogen fertilizer for cabbage under our country is vital condition. Generally, may cause a great loss on growth, productivity and nutritional quality of cabbage. Therefore appropriate use of nitrogen fertilizer for the plant can solve the affects growth of the cabbage. However Nitrogen level have to be regulated to obtain high yield from cabbage, Thus its require applying of appropriate of fertilizer for the enhanced cabbage productivity and sustainable yield many experiment shows that nitrogen application increase the total yield of cabbage (patrick *et al.*, 2012).

1.2 Objective

- To review the effect of different rates of nitrogen fertilizer on growth and yield of cabbage

2. Literature Review

2.1 Description and Origin of Cabbage

Cabbage is originated from wild non-headed type colewort (*Crambecordifolias*) from Western Europe and northern shore of Mediterranean. It is originated from Western Europe and Northern Shore of Mediterranean region where it has been grown for more than 3000 years. The genus *Brassica* includes about 100 species majority of which are native to Mediterranean region. It has chromosome number $2n=2x=18$ (Abraham, 2009).

Cabbage (*Brassicaoleracea* var. *capitata* L.) is also known as Cool vegetable crops. It belongs to family Brassicaceae (or Crucifer) and generally referred as Brassicas. It is important groups of crop worldwide. It is dicotyledonous biennial crop, but it is grown as annual. Cabbage form several different head shapes: pointed, conical or oblong, round or drummed shaped. Cabbage generally classified as headed which is round, oval or flat. Chinese head cabbage is oval and flat, moreover it is loosely formed and light in weight. Head formation in cabbage is quantitative trait controlled additively with low dominance effect. It is only head cabbage that changes in leaf shape becoming wider because of the shorter petiole length with increasing leaf position and thus cabbage acquired the developmental change in leaves (Abraham *et al.*, 2009).

2.2. Importance of the cabbage crop

Cabbage is grown for its leaves and commonly used as vegetable. Cabbage is an excellent source of mineral such as calcium, iron, sodium, Potassium and phosphorus. It has substantial amount of beta carotene, ascorbic acid and others. It has calories (27%), fat (0.1%) and carbohydrate(4.6%0. It is good source of protein (1.3%) which contains all essential amino acids; particularly sulfur containing amino acids (Abraham *et al.*, 2009). The only part of the cabbage plant that is normally eaten by human being is the leafy head; more precisely, the spherical cluster of immature leaves, excluding the partially

unfold outer leaves. Cabbage is used us row in salad such as coleslaw, as a cooked vegetable, or reserved in pickle or sauerkraut. Flavor in cabbage is due to the glycosides singing (Abrham *et al.*, 2009).

A100g edible portion of cabbage contains 1.8mg protein, 0.1mg fat, 4.6mg carbohydrate, 0.6g mineral, 29 calcium.0.8mg iron and 14.1mg sodium (Banchalem Adisu *et al.*, 2010).

2.3 Cabbage Production in Ethiopia

Ethiopia has a variety of vegetable crops grown in different agro- ecological zones by small farmers, mainly as a source of income and food. Commercial producers are also involved in the production, processing and marketing of vegetable. These crops are produced under rain fed and irrigation conditions. It is produced both in cereals based cropping system and in monoculture. Largely cabbage is produced by irrigation rather than rain fed. At present different crops are produced in many home gardeners and also commercially in different parts of the country. But most of the production is by small holder. Cabbage production in Ethiopia is scattered in the high lands but the larger production is found at the central high lands of the country (Fekadu *et al.*, 2006). Input and Supply Enterprise) are in the importation of seed and this has influenced the national market (Memar, 2010).

2.4 The Role of Nitrogen on growth and yield cabbage

The doubling of Agricultural food production worldwide over the past four decades has been associated with a seven fold increase in use of nitrogen fertilizer. As the consequence of, both the recent and future identification of the use of nitrogen fertilizer in agriculture already has and will continue to have major determinate impact on agriculture (Herei, *et al.*, 2007) [9]. Plant takes up nitrogen in the form of nitrate or ammonium for organic matter, in organic matter and fixation of free nitrogen by microorganisms. Nitrogen play important role in protein formation as component of chlorophyll. Chlorophyll is required for light energy absorption process of photosynthesis. Therefore, adequate nitrogen supply enhances the amount of chlorophyll as result of increase photosynthesis (More, 2006) [12]. The deficiency of nitrogen reduces the formation of chlorophyll, as result plants lose their green color leading to reduction of the rate of photosynthesis. Therefore, nitrogen is the motor of plant growth and being the essential constituent of protein is involved in all major processes of the plant development and the yield formation. It stimulates vegetative growth and encourages the development of large stems and leaves. Nitrogen tends to produce succulence, a quality of great important in many vegetables (More, 2006) [12].

An adequate supply of nitrogen is associated with vigorous growth and a deep green color. Since nitrogen favors growth, it may delay maturity of fruits and seeds. Excessive quantities of nitrogen can under some condition prolongs the growing period and delay maturity (More, 2006) [12]. This is most likely to occur when adequate supplies of other plant nutrients are not present. All plants require sufficient of macro nutrients for healthy growth and nitrogen is a nutrient that is commonly in limited supply. Nitrogen deficiency in plants can occur when organic matter with high carbon content, such as saw dust is added to soil. Soil organisms use any nitrogen to break down carbon source, making nitrogen unavailable to plants. This is known as "robbing" the soil of nitrogen. All vegetables apart from nitrogen fixing legumes are prone to this disorder. Nitrogen deficiency can be prevented in the short term by using grass mowing mulch, or foliar feeding with manure, and in long term

by building up levels of organic matter in the soil sowing green manure crops such as grazing rye to cover soil over winter will help to prevent nitrogen leaching, while leguminous green manures such as winter tares will fix additional from the atmosphere (Sanderson *et al.*, 1999)^[18].

Nitrogen rate had significant effect on yield of cabbage and on leaf length of cabbage. It plays an important role in the health and growth of all plants, and it is responsible for the green leaves you see growing on them. Nitrogen helps plants photosynthesize, which is a process that involves using energy from the sun to break down water and carbon dioxide so that sugars are formed. Cabbage requires nitrogen rich fertilizer. Nitrogen is vital for the leaf growth of cabbages to begin. Cabbage is a heavy feeder because of the intensity of its leaf development, so it's important to add a second helping of nitrogen rich fertilizer 6-8 weeks after transplanting, especially if lots of rain has fallen (khabo 2009).

2.5 Application of Excess and Lower Nitrogen Rates On The Growth And Yield Of Cabbage

Excess nitrogen in fertilizer can be just as troublesome as not enough. It can lead to excessive vegetative growth in the plant at the expense of flowering and fruiting. Besides these undesirable effects on the crop or plant, excess nitrogen can cause problems in the environment at large. Rainwater runoff can carry the excess nitrogen from fertilizers into ground water or into surface water. When this occurs, nitrogen becomes a pollutant. In surface waters, it stimulates excessive growth of algae and other nuisance plants. Abraham *et al.*, 2009 Cabbage -size reduced with nitrogen deficiency the foliage became yellowish -green (chlorotic). The symptoms starts from the older leaves and after awhile the whole plant became chlorotic, some leaf parts may have reddish orange flush the shep of the leaves remain normal. Growth is strongly restricted crop development is delayed and older leaves may decay with sever nitrogen deficiency, nohead is formed. (Adina, 2009)^[2].

2.6 Effect of Nitrogen Rate on Growth Parameters of Cabbage

2.6.1 Plant height

The level of nitrogen had revealed non-significant effect on mean plant height. This because of the fact that nitrogen is responsible for vegetative growth of plant length. Easmine *et al.* (2009) reported that increased nitrogen from 0 to 250kg/ha increase plant height from 36.16 to 47.72cm respectively. This was measured by using ruler from ground level to the tip of the outer longest leaf of individual plant. Bancalem, 2010 Mean number of leaves per plant at physiological maturity was not significantly affected by Nitrogen fertilizer. This is due to the fact that at maturity, cabbage leaves were folded and number of unfolded leaves was decreased. This result is in agreement with the findings of (Pankaj, 2006)^[16].

2.6.2 Leaf length

Application of nitrogen fertilizer significantly ($p < 0.05$) influenced leaf length of Cabbage. The longest leaf length (20.10cm) will obtain from the plot that received 150kg of nitrogen per hectare when compared to the control (0kg nitrogen per hectare) which was 16.16cm. The positive effect of nitrogen (N) on leaf length might be due to its key role in the synthesis of chlorophyll enzymes and protein. who reported that adequate applications nitrogen, promot vigorous growth and dark green color of Cabbage and also nitrogen is important in formation of chlorophyll and also component of protein, similarly Souza *et*

al. (2008). Reported that application of 200 kg N ha⁻¹ significantly enhanced the length of cabbage leaves. Pankaj (2006)^[16] also reported that application of N at 150 kg ha⁻¹ gave the best result with regards to cabbage leaf length.

2.6.3. Leaf width (cm)

The level on nitrogen had revealed significant ($p < 0.05$) effect on the leaf width of Cabbage. The widest leaf was 21.18 and was obtained from 150kg N/ha. However, it was not significantly different from that of 100kg N/ha (18.7) while the narrowest leaf was (16.9) obtained from 0kg of nitrogen per hectare (keteseeman, 2006).

2.7 Effect of Nitrogen on Yield Parameters of Cabbage

2.7.1 Fresh weight (gm/plant)

As the time of harvesting from the selected five plants by taking three heads and then measured by sensitive balance in laboratory (Tesfaye, 2009)^[20]. Than Amir M. 2009 will measured from four plants and taken from the two middle rows of each plot by using sensitive balance before oven drying and their average will be taken after harvesting (Amir, 2009). Then Amirs M. Fresh weight is better than Tesfaye. Freshweight. This was recorded from eight plant per plot (two central rows) resulting total yield per net plot. The whole plant part were using the bean. Balance (Model WA.3 10 rev-B aeadam equipment mede in china). Application of nitrogen fertilizer at different rate also showed a very highly significant effect on freshhead weight per plant). Increasing nitrogen level from 0 to 150 kg ha⁻¹ resulted in progressive increase in head weight of cabbage. Cabbage grown at 150 kg ha⁻¹ of nitrogen rate had the highest head weight per plant (0.771 kg /plant), however the result is similar with 100 kg/ha while cabbage grown without nitrogen fertilizer had the lowest (0.442 kg/plant) fresh head weight. This is due to nitrogen that increases the vegetative growth and produces good quality foliage and promotes carbohydrate synthesis through photosynthesis and ultimately increased yield of plants (Mengel and Kirkby, 2006)^[11].

2.7.2 Dry weight

According to Tesfaye D taking one plant per plot and chopping then after the sample will at 120^oc and dry mass will measure by sensitive balanced (Tesfaye, 2009)^[20]. Amir M Plant will remove from soil and washed of any lost soil then the plant will be cool down and put in the oven dry and weighted in gram. It will be taken after harvesting (Amir, 2009)^[3]. Regarding to the dry matter contents, nitrogen fertilizer highly significantly influenced the mean head dry weight. The increasing levels of nitrogen encouraged head with a significantly higher dry weigh as compared to the control plot. The maximum dry weight of cabbage head (0.114 kg per plant) were recorded with application of 150 kg ha⁻¹ of N whereas, the minimum dry weight (0.043 kg per plant), were detected in the controls plot. There were no significant difference between plots that received 100 and 50 kg N/ha (Mengel and Kirby, 2006)^[11].

3. Summary and Conclusion

Cabbage is one of the most feeder of plant nutrient includes nitrogen and highly response nitrogen. It is one of the most popular and widely growth vegetable crops in the world. It is respond well to nitrogen fertilizer and adequate fertilizer is particularly important in the cabbage growing area. Nitrogen promotes the growth and it is one of the most important nutrient affecting the growth, development and quality of the plants. The growth and development the stage must be considered when

nitrogen applied to match the nutrient plant demand. The study was conducted to investigate best dosage of nitrogen for vegetative growth and yield and to recommended level of nitrogen rate. Cabbage can be grown at any time of the year but better quality and greater yields can be obtained during warmer months of the year.

Nitrogen rate has a significant effect on leaf length of cabbage. Similarly leaf width of cabbage had significant difference between different rates of nitrogen. Cabbage is an excellent source of mineral such as calcium, iron, sodium, Potassium and phosphorus. Nitrogen helps plants photosynthesize, which is a process that involves using energy from the sun to break down water and carbon dioxide so that sugars are formed. Nitrogen rate had significant effect on yield of cabbage. As preeminent as nitrogen is to plant physiology, many other nutrients in fertilizers are essential as well. Excess nitrogen in fertilizer can be just as troublesome as not enough.

4. Recommendation

According to this senior seminar, its recommended that important to do research's and know there optimum rate on nitrogen fertilizer rate with time of application, spacing, irrigation, frequency, disease and pest management and cultural practice based on the above factor to conduct of cabbage research are necessary to increase cabbage growth and production or output of cabbage. Optimum nitrogen rate apply good production and quality of cabbage.

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