Nitrogen Use Efficiency: Farming Practices and Sustainability

Abstract:

It is expected that up to 2050, human population will be doubled. Agricultural researchers are striving their best to meet the food challenges. To get the higher yield, nitrogenous fertilizers use is also being increased. Nitrogenous fertilizers play vital roles in different plant's growth and developmental processes. But, excessive use of nitrogen is no more beneficial to plants. Only 30 to 50 % nitrogen use efficiency is recorded in plants, the remaining nitrogen is used by soil microbes, leached down in soil profile or volatilized. Different agronomical practices have been practiced and suggested for the general cultivation. Proper use of these agronomical practices can increase the crop yield and nitrogen use efficiency.

Introduction

Nitrogen (N) is an essential plant nutrient needed for growth and development, it improves the yield of agricultural crops. Additionally, nitrogenous fertilizers are the necessary and healthy inputs for all the crops grown globally. With advantages, it is also prone to series environmental problems in aquatic ecosystems. Nowadays, the main problem due to overuse of fertilizers is eutrophication. So, misuse of any fertilizers creates problems in our surrounding. Instead of formulating different strategies to farmers, it is being expected that N fertilizer consumption will be increase globally from 112.5 million tons to 118.2 million tons and population growth expected to reach 10.5 billion in 2050 and the demand for feed, food, fibre, and fuel[1].

Commonly, fertilizers are considered as a vital part of inputs to increase the crop's production, but the excessive use of nitrogen can lead to reducing the full potential of crop's output. This excessive part is leached and cause environmental problems and human health hazards [2]. The plant shows only 30-50 % nitrogen use efficiency (NUE). While, the remaining nitrogen is used by soil microbes, leached down in soil or volatilized. Healthy plants retain 2-4 % Nitrogen[3]. Nitrogen plays an important role in the preparation of proteins. In the case of Nitrogen deficiency, the plant's growth is stunted[2]. From the previously performed experiments, it has been noted that excessive nitrogen is lost from the soil profile. In high rainfed areas and light texture soils (sandy soil), leaching is a common problem. Further, nitrate which is the form of nitrogen does not strongly adsorb on soil surface because

nitrate is the moveable in nature, and easily move beyond the soil profile by process of leaching. Through this mechanism almost 25 % applied nitrogen can be lost [4].

There are various ways to remove the nitrogen from the soil profile, like nitrogen can be lost through the water as well as wind erosion. Loss of N through water erosion is a major problem for humid and sub-humid climatic areas while wind erosion is a more commonly reported problem of nitrogen loss in the arid and semiarid climatic region[5]. Except leaching problem, nitrogen unavailability from the soil is also due to less fertility. But, excessivea use of nitrogen also declines the crop yield. Different kind of practices are being used to improve nitrogen use efficiency (NUE). The main objective of nitrogen use efficiency (NUE) is to enhance the performance of the overall cropping system. Nitrogen use efficiency (NUE) also addresses the sustainability of agriculture system with respect to soil fertility and some other soil quality components[6]. Nutrient experts evaluate different nitrogen management strategies; right time, right place as per the requirement of the crop[7].

In this review, we have discussed about the increment in fertilizers use for getting the higher crop yield. Because, population is continuously increasing, and it is necessary to increase the food production. Beside the nitrogen use, it is also necessary to care while applying the fertilizers. Because, the misuse of nitrogen is creating an alarming situation for our surrounding environment. To address the problem of nitrogen overuse, all possible major and minor practices have been discussed in this review. By following these practices, nitrogen use efficiency and crop yield can be improved.

Nitrogen is a Key and Basic Element for Crops:

It’s the foremost objective of agricultural scientists to increase the food production as population is increasing day by day. But, environmental protection is also an important factor to save our environment from the harsh climate change[8]. To meet the food chalenges, nitrogen use is being increased. In the past 4 decades, its use has been increased to 100-fold[9]. Now, scientists are doing experiments to develop those crop varieties that utilize nitrogen efficiently and in a quick way[3]. So, For the lavish growth of plants, macronutrients are very important components of plant’s development and other mechanisms. Nitrogen is one of them that is responsible for the full-fledged growth of crops. In the last years, agricultural scientists around the globe are taking interests to set the optimum use of nitrogen for the optimum growth of agricultural crops[10].

Healthy plants contain 2-4 % nitrogen. Deficiency of nitrogen results in the appearance of chlorosis in plants and protein quantity is decreased. Protein is made by carbon compounds, and without the availability of nitrogen, these are not synthesized[11].

Not only for crops, but nitrogen is also is an important element for other living organisms. But, it is counted as the most limiting factor only for the plants. Optimum use of nitrogen can give the maximum output, and can lead to maximum productivity of plants[12]. Both micro and macro nutrients are playing substantial role for the plant development. So, deficiency of macronutrients results in the stunted growth. To get the higher production, nitrogenous fertilizers are applied in excess amount. And, this excessive use does not become the part of plant's system as it leaches down from the soil profile and becomes the part of soil pollution. It is recommended to use the fertilizers according to the requirement of plants. In these ways productivity and profitability are increased. Besides the nitrogen loss and yield problem, it also decreases the chlorophyll content. So, measurement of chlorophyll content can give the idea of nitrogen's requirement[13]. Photosynthetic activity of plants is increased as plant assimilate more nitrogen. Majority of the leaf nitrogen is represented by the proteins of the calvin cycle and thylakoids[14]. In one of the published papers, nitrogen and chlorophyll content were measured at the flowering stage and found the close relationship between nitrogen content and chlorophyll content. Moreover, chlorophyll structure is composed of nitrogen[14]. Further, figure 1 is showing the comaprisen between optimum and excessive use of nitrogen

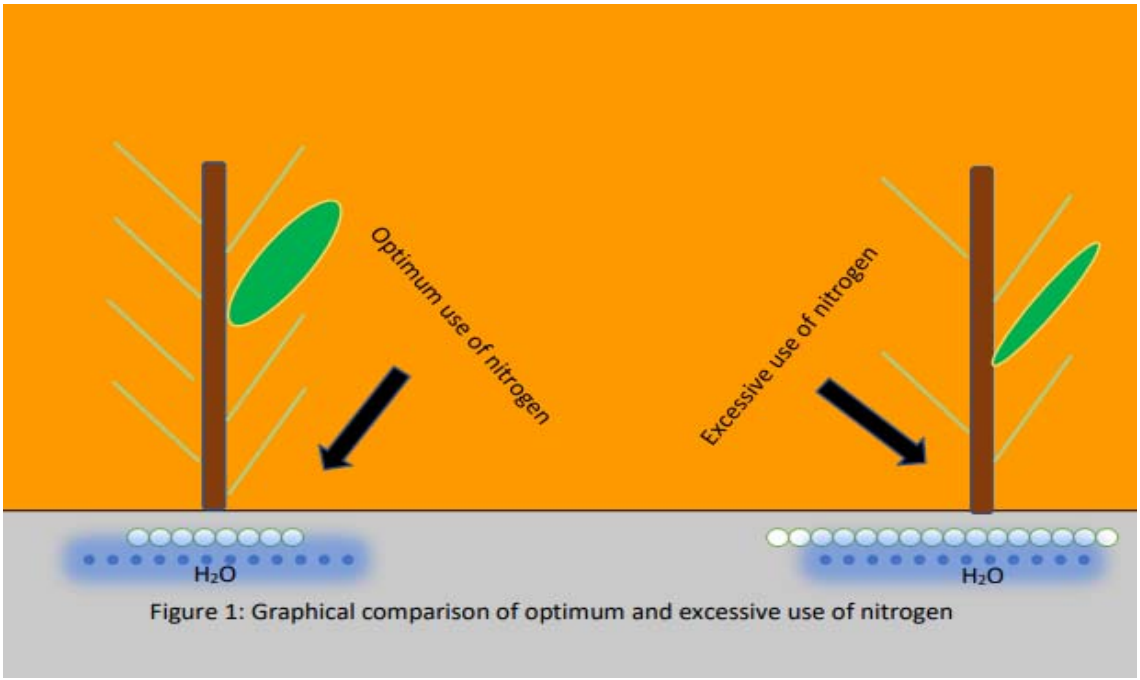

Figure 1: Graphical comparison of optimum and excessive use of nitrogen

Excessive Use of Fertilizers:

Soil fertility is declining continuously. It is considered the main problem of the green revolution era. Intensive cropping is also a responsible factor for the removal of soil nutrients. Possibly, Farmers are not well aware of the proper use of nitrogen fertilizers and apply without indiscrimination. More than required quantity is applied to the agricultural soils, and many other macro and micronutrients are ignored, including Potash, Phosphorus, Zinc e.t.c. Upon application of fertilizers, mineralization is started and it depends upon different factors, including soil microbes, irrigated water, and type of fertilizer[15]. Excess of the nitrogen is lost to running waters and enters in the freshwater lakes, and algal growth appears on the water surface. Due to the algal growth, the aquatic organisms under the water surface die[16]. In this problematic critical conditions, it is necessary to increase the use of Inorganic fertilizers as it is helpful to replenish the soil nutrients.

Besides the removal of nutrients removal, excessive use of nitrogen fertilizer creates many environemntal problems. Continuous use of huge quantity also leads to elevation of nitrate-nitrogen (NO_3-N) concentration in the groundwater, causing human health disorders. With the groundwater, it is also affecting the surface freshwater resources and becoming the major factor of water pollution[17]. It is quite odd that to increase food production, more and more fertilizers are being applied in agricultural land, but nobody cares about environmental pollution. Global nitrogen cycle has been changed effectively[18].

Plants use 30-50 % nitrogen, while the remaining is wasted in the form of microbes food and leaches down from the soil profile[19]. NH_3 (ammonium) contains 82% nitrogen and plants can use it directly. When plants are unable to use that ammonia, it is converted in nitrates and enter into soil profile and cause the source of soil pollution. Like plants, humans are also the victim of nitrates and becomes the part of vegetables that causes severe human health problems[20]. In the agricultural system, these effluents disseminate in the environmental air in the form of ammonia (NH_3)and nitrogen dioxide (NO_2) gasses. These are highly toxic to human and animals health. Therefore, it is a serious concern of present era and a difficult challenge for the researchers to reduce the excessive consumption of nitrogenous fertilizers in the agriculture sector. In one of the performed research, it was revealed that if nitrogen content increases, the nitrate concentration in lettuce is also increased[21]. To get sustainable

production and a clean environment, nitrogen use efficiency (NUE) should be increased. It is dependent upon the performance of different management practices. By doing well management practices, nitrogen use efficiency (NUE) can be increased[22].

Losses of Nitrogen:

(a) **Nitrogen losses in the field**

Nitrogen is a major component of nitrogenous fertilizers. Some of its quantity is taken up by the crops and utilized for their growth and development, but also some quantity of the applied fertilizers are lost by the processes of de-nitrification, soil erosion, surface runoff, leaching and volatilization of ammonia[5].

(b) **Soil erosion and surface runoff:**

From the soil profile, nitrogen can be lost through the water as well as wind erosion. Loss of nitrogen through water erosion is a major problem for humid and sub-humid climatic areas while wind erosion is a more commonly reported problem of nitrogen loss in the arid and semiarid climatic region. Due to wind and water erosion fertility is soil is also reduced as essential nutrients move away from their original place[5].

(c) **Loss through leaching and microbes:**

In high rainfed areas and light texture soils (sandy soil), leaching is a common problem. Nitrate form of nitrogen does not strongly adsorb on soil surface because nitrate is moveable in nature, and easily move beyond the soil profile by process of leaching. 25 % nitrogen is wasted due to this process[23]. This loss can be highly dependent upon the quantity of nitrogen applied, climatic conditions and crop production systems[22]. Different kinds of areas have different climatic conditions. Arid and semi-arid areas do not cause significant loss of nitrogen. Except the soil properties, soil organisms are also responsible for the nitrogen loss from the soil profile as soil microorganisms use much quantity of applied nitrogen. So, plants do not use optimum amount for their normal growth and productivity[24].

(d) **Ammonia volatilization and denitrification.**

When ammonium or urea is applied to the surface of the soil, nitrogen is lost in the gaseous form through the reduction process (volatilization) in which NH_4 converts in NH_3 gas. The application method also determined the loss ratio as nitrogen loss is more severe when

chemical nitrogenous fertilizers and organic manures are applied on soil surface through broadcasting method[5].

Losses of nitrogen in the form of ammonia is a major problem for the alkaline soils. The above discussed mechanism is mostly common in alkaline kinds of soil and warm climatic conditions. It causes 20 % of nitrogen loss by volatilization and goes to the atmosphere within a short period[5].

Responsible Factors for Low Nitrogen Use Efficeincy (NUE):

40 % of farmers rely on nitrogenous fertilizers to get maximum yield. Maize is using 56% of the total nitrogen production. From the total applied fertilizer, only 50% is utilized by plants. While the remaining one is wasted in the form of environmental pollution[25]. The efficiency of applied nitrogen fertilizers depends upon its demand and losses. Crop environmental and management factors affecting nitrogen use efficiency. Agronomic management can increase the nitrogen use efficeincy (NUE) as it depends upon the implementation of efficient strategies to use fertilizers according to the need of crops. Farmer's fields did not show a significant increase in nitrogen use efficeincy (NUE), but it depends upon the agronomical management strategies. Inefficinct agronomical management practices, soil physical & chemical properties, and genotypes can cause 18 %, 5 %, and 12 % losses, respectively. And, due to less fertility, 50 % of agricultural lands are not producing the crop with the full yield potential. So, in these all circumstances, improper use of nitrogen declines the crop yield[6]. Except of the reduced yield problems, overuse of nitrogen can also reduce the photosyntheitc activity[26].

Influences of Different Agricultural Practices:

Worldwide, agriculture land is finite for the production of food. To meet the demand for food, production per unit area should be increased. To utilize the agricultural land efficiently, proper planning and management strategies should be applied. According to the estimated statistical report, by 2050, the population will be increased to 9 billion, and to feed the whole world, we will be needed to increase the food prodution two times[27]. No doubt, increased nitroenous fertilizers rate can increase the production, but optimum use is the key point to achieve this target. Upon the unreasonable use of the nitrogen fertilizers, its yield is decreased. Appropriate methods, time and application rate always matter. Otherwise, increased nitrogen rate is no more useful for plants and lost from the soil profile[28]. Different

methods of fertilizers are being applied. Again, the point matters; which method is suitable to increase the nitrogen use efficiency?

Before the cultivator use, fertilizers are applied across the whole field; its called a broadcast method. This method results in the distribution of non-uniform fertilizer rate across the filed. Some places receive more fertilizers. Banding fertilizer method is used to place the fertilizers near the roots, and it is helpful in decreasing the costs and kills weeds maximum. This study was carried out to check the soil respiration, physiological parameters, and yield. It showed that maize behaves differently in different agricultural practices. Still, differential behaviour of maize is not completely understood. Application methods showed different behaviors. Different parameters including, transpiration, photosynthesis, plant height, soil respiration, and yield were measured to asses the differences by adopting six different agricultural practices. Different results showed that application methods do not give significantly different results but the agronomical management practices increase the production of maize[29]. Likewise the fertilizer application method, application rate also matters a lot for increasing the maize production and nitrogen use efficiency. According to the quoted published report, five different nitrogen rates (0, 45, 90, 135, 180) kg ha^{-1} were applied. Among these application rates, average estimated rate, 130.1 and 131.5 kg ha^{-1} have proved to produce higher grain yield[30].

Nowadays, new sources of fertilizers are being applied to increase the production and nitrogen use efficiency of plants. Controlled release urea (CRU)is being applied to get the maximum nitrogen use efficiency (NUE). Controlled release urea (CRU) is coated with less soluble compounds that make it efficient to use gradually[31]. According to another study, the researcher checked the controlled release urea (CRU) effects on potato and environment. Results clearly depicted that controlled release urea (CRU) decreases the NH_4^+ and Nitrates No_3^-, thus it does not permit to emit different gasses and increases the NUE[32]. Different studies proved that split nitrogen fertilizer application time is a determinant of higher yield and increase the nitrogen use efficiency. Pre-planting application and side dressing, both are highly effective techniques to increase the yield and nitrogen use efficiency. Thus, the timing of fertilizer can synchronize the demand and uptake of nitrogen fertilizers[29].

If management strategies are ignored, the full potential of maize yield and nitrogen recovery efficiency cannot be achieved. One another group carried out an experiment by using the labeled nitrogen. Nitrogen was applied at five different stages, including Oat tillering, before 15 days of maize planting time, at the time of corn planting, at three-leaf growth stage V3, split application at V3 and six-leaf growth. Early nitrogen application is not suited for the

availability of nutrients to plants. Soil microbes use the early applied fertilizers and they make it unavailable for plants. Suitable timing of fertilizers increases the nitrogen recovery efficiency and nitrogen content[33].

Need to Increase the Nitrogen Use Efficiency (NUE):

(a) **The concept and importance of nitrogen use efficiency (NUE)**

Meeting this requirement in a sustainable manner is a big challenge today, especially when parallel to historical cereal yield trends which have been linear for nearly half a century. Improving nitrogen use efficiency (NUE) is environmentally and economically desirable trait for crops. Nitrogen use efficiency (NUE) is an emerging concept for assessing crop production systems and highly influenced by fertilizers management.

(b) **Nutrient use efficiency**

The main objective of nutrient use is to enhance the overall productivity of cropping systems in sustainable manners and should minimize nutrient losses from the agricultural fields. Nitrogen use efficiency (NUE) also addresses the sustainability of agriculture system with respect to soil fertility and some other soil quality components[34]. Therefore, the main objective of nitrogen use efficiency (NUE) is to enhance the performance of the overall cropping system. 78 % nitrogen is present in the air but it can not be utilized directly by plants. One acre has al most 34, 000 tons nitrogen but its direct use is impossible for plants. Nowadays, for the increment of food and make efficient use of nitrogen, highly effective management strategies are needed[35].

Synthetic nitrogen fertilizers use is being increases. These are soluble in water and can be readily available to plants. Most of the countries are dependednt upon these synthetic fertilizers for providing alternative source of nitrogenous fertilizers. In the world, China is the leading importer of chemical fertilizers. According to one of the published study, for agricultural outputs, China is consuming 30% of the world's total nitrogen production[18]. Although, Harbor-Bosch process works for making synthetic fertilizers. And, it is the great invention of the 20th century. But, differential and improper use of nitroegn disturbs the plant's output and creates health hazardous for humans.

However, alone nitrogen is not highly useful for plants to boost the production of crops. In the 19th century, two scientists put forth the law of the minimum, this law clearly states that in the absence of phosphorus or potassium, nitrogen can not give fruitful results. It shows nil

behavior as increased nitrogen rate can not give more yield. Hence, It's a very difficult task to manage the fertilizers according to the requirement of plants.

While leguminous crops perform better due to their higher nitrogen use efficiency because it is stored in the root system, and does not lose in soil or in the air. Nitrogen use efficiency (NUE) is a very complex trait that is associated with the genetic and environmental (G-E) interaction. By observing and analyzing these worst conditions, It is highly needed to increase the crop's nitrogen use efficiency (NUE). Therefore, different breeding schemes and biotechnological tools are employed to develop new plant lines with higher nitrogen use efficiency (NUE). However, the use of nitrogen can also be improved by designing proper management strategies. According to one of the study, the main problem in the decrease in nitrogen use efficiency is that farmers apply more nitrogen before planting. By doing proper management and previously performed experiments, farmers should use the knowledge and wait for the time of active nitrogen absorption[1].

Different kinds of agricultural practices are being used to increase the nitrogen use efficiency (NUE). For managing the optimum use of nitrogen, the first step is to do the analysis of crop and soil. Soil analysis components are used to manage the nitrogenous fertilizers, including a quantity of soil organic matter, nitrogen-nitrate credit from the previous crop data, yield targets, and nitrogen credit from irrigation water and manures. Variable nitrogen management zones (MZ) should be identified to apply the fertilizers accordingly. In this way nitrogen use efficiency (NUE) can be improved. By applying the nitrogen fertilizers according to the demand of specific soil parts, plants perform uniformly and give maximum and uniform yield[36]. For example, by making a comparison to wheat, corn needs less nitrogen for a given biomass[37]. Another technique to determine the nitrogen requirement is to predict yield target by having knowledge about the previous 5 years performance. Some researcher finds it useful if growing conditions are favorable. If, the climate is not good then its not followed. Because, bad weather conditions are not suitable to take the right decision[38],[39].

Worldwide, agriculturist try to work beyond the thinking and solve the problems by utilizing the research skills. Nowadays, there are many model plants are present and these are used for responsive indicators to fertilizers, weather, and soil. For example, increased nitorgen use can also increae the chlorophyll effieincy. So, these plants show the concentration in the form of their phenotypic appearance. So, as chlorophyll content is increased, the photosynthetic activity also increases. Previous studies showed that photosynthetic activity has a positive correlation with nitrogen concentration[40]. Nitrogen concentrations are used as an indicator of maximum crop growth. Critical nitrogen requirement is the optimum amount of nitrogen that

can produce maximum yield. Initially, in the plants, nitrogen concentration is higher than the maturity level. As plants grow, nitrogen concentration is decreased[41].

The ratio of actual available nitrogen in plants to the critical nitrogen level is called a nitrogen nutrition index (NNI). Now, agricultural scientists are using the NNI (nitrogen nutrition index). This approach is being used in wheat, rice, sorghum, and grasses[42]. In maize, this approach can not be used with much efficiency. At early growth stages, critical nitrogen cannot provide a reliable nitrogen status[43]. Up to silage maturity, critical nitrogen dilution curve gives effective results. In corn, this system could be used only at small scale[44].

Strategies to Enhance NUE:

(a) **Agronomic practices**

Nutrient use efficiency can be enhanced by adopting local as well as scientifically available means of nutrient management practices. These practices can ensure more efficient use of various agricultural inputs such as fertilizers, irrigation water, and chemicals. These management practices can also minimize the nutrient losses and enhance the nitrogen use efficiency (NUE). Strategies used for enhancing the nutrients use efficiency of crops should be focused on two major bases (1) either it enhances the efficacy of externally applied nutrient (2) or it enhances the budget of nitrogen in the soil by reducing nitrogen losses through different mechanisms, and ensure more uptake of conserved nitrogen by crops[45]. Application of the nutrients at a suitable rate, right time, and in the right place is the major and basic principle for attaining the higher nutrients use efficiency[46]. Best nutrient management in wheat-maize cropping systems should aim to apply fertilizers based on the requirement of crops and select a suitable method for maximizing the nutrients use efficiency and reduce its losses[47]. Now, agriculturists are diagnosing different N management strategies; right time, right rate, right method, right place[7].

(b) **Right rate**

Several crops are highly dependent on location, climate and season, so it is essential that accurate yield goals are established, and specific rate of fertilizers should be applied to meet the target yield. Excess or low supply of the nutrients will result in reduced nitrogen use efficiency (NUE) and cause significant losses in grain yield and grain quality. To overcome these problems, soil testing is done. Soil analysis is also one of the most powerful and easily conductible tools for determining the capacity of the soil for providing the nutrient to crops.

Soil testing approaches also be useful for formulating appropriate fertilizer recommendations and good calibration data in the proper way[7].

(c) **Right time**

Great relation between crop requirement and nutrient supply is necessary to enhance the nitrogen use efficiency (NUE). Fertilizers should be applied in different split doses as it increases the nitrogen use efficiency and yield is also increased. During the growing season, application of nitrogen in split doses rather than a single dose at a time is known to be effective in increasing the nitrogen use efficiency (NUE). For assessing the nitrogen status of the growing crops, tissue testing is a cheapest and famous method. But, other diagnostic techniques are also commonly available. The use of chlorophyll meters also found as an easy diagnostic tool for enhancing the nitrogen use efficiency in crops[48]. Use of leaf colour charts also recommended for the crops when nitrogen is applied in split doses[49].

(d) **Right place**

Selection of suitable application method has always been crucial in ensuring the nutrients use efficiency. Right fertilizers placement is very essential to use the optimum rate of fertilizers. Different placements are available, but surface or subsurface application methods are more common. Prior to planting, nitrogen can be broadcast or applied as a band on the soil surface, or it is applied as a subsurface band (15-20 cm deep). Commonly, with the banded application method, nutrient recovery efficiency tends to be higher as compared to another method. Under this application method, there is less nutrient contact with the soil which reduces the chances for the nutrient loss by the leaching process.

Selection of the fertilizer's placement method is highly dependent on the crop and edaphic factors as both interact to influence the availability and uptake of nutrients. Average and balanced application of nutrients is one of the most common practices for enhancing the efficacy of nitrogenous fertilizer both in developed and developing countries[34].

(e) **Chlorophyll meter and leaf colour chart**

Chlorophyll meter (CM) can be successfully used to estimate the crop nitrogen content because most of the nitrogen is found in the chloroplast of the plant. Chlorophyll meter (CM) helps in measuring the chlorophyll content and can calibrate it for the different climatic, soils and crop cultivars. It is also being recommended to check the effectiveness of late applied nitrogen in standing crops to enhance the protein content and crop productivity. Leaf color chart also used as an indicator of leaf color, color intensity, leaf nitrogen status and helps in

selecting the right time of nitrogen application. As a diagnostic tool, it also provides the guideline to the farmers for making appropriate decisions regarding appropriate time, appropriate dose and right method of nitrogen application in standing crops. As concluded, it works on the base of relative greenness of leaves which directly co-related with chlorophyll content of leaves[50].

(f) **Integrated nutrient management**

Integrated nutrient management involves balanced use of indigenous nutrient components such as crop residues, organic manures, biological nitrogen fixation as well as chemically available nutrients as their complementary interactions help to increases the recovery of nitrogen. Positive effects of the integrated use of organic as well as inorganic nitrogen are either due to optimum physio-chemical conditions of the soil or due to the better architecture of root and more supply of micronutrients to the plants[50]. The exploitation of these positive points among the plant nutrient is the important role players for increasing the productivity of cropping system as well as the efficiency of applied nitrogen. The paired interaction of nitrogen with other secondary and micronutrients could result in improvement in crops yield and nitrogen use efficiency. Therefore, a balanced and judicious use of nitrogenous fertilizers will lead to achieving higher productivity.

(g) **Use of modified fertilizers and slow released fertilizers**

These are various fertilizer products which are used for enhancing the fertilizer use efficiency of crops by reducing losses of nutrients associated with the production system. These products are based on two basic concepts either they can release in slow or either interfere with the nutrients transformation processes and thus reduce their losses[48]. Slow release nitrogenous fertilizers and inhibitors are two important classes of fertilizers. The selection of the suitable type of applied nitrogenous fertilizers has a pivot role in reducing the various nitrogen losses hence, affecting the availability and recovery of nitrogen. Compare with ammoniums and amide containing nitrogen fertilizers, nitrate fertilizers are more susceptible to leaching. But in contrast, ammonium and amide containing fertilizers are more susceptible to volatilization process than nitrate fertilizers. A variety of slow-release fertilizers are now easily available in the market which has the potential to increase the nitrogen use efficiency and reduces the nitrogen losses[48]. Polymer-coated products are commonly used in agriculture, which can be designed to supply the nutrients to crops in a controlled manner. Nutrient release rates are highly dependent on the properties of the polymer coating, soil temperature,

and moisture conditions. In developing countries, non-availability and high manufacturing cost are two major reasons for the limited use of these compounds[51].

Conclusion:

To increase the crop production, fertilizers play pivotal roles. Among different fertilizers, nitrogen is one of the most important as it helps the plants in the preparation of protein, lavish growth, metabolic processes and growth. Its deficiency effects the growth of the plant and its excessive use reduces the crop yield. Plant uses an optimum level of nitrogen and the remaining is leached down from the soil profile. The excess of nitrogen in the field causes environmental problems and health hazards as it leaches down from the soil profile and enters in the fresh water lakes that cause eutrophication. Further, due to excessive use of nitrogenous fertilizers, Plants reduce their nitrogen use efficiency (NUE). Hence, it is the need of the current era to increase the nitrogen efficiency. Different experiments are ongoing to increase the nitrogen use efficiency (NUE) of plants. Additionally, agronomic practices can also help in this regard. Nitrogen should be applied at the right time, right place and right method. Thus, it enable the plant system so strong to use the nitrogen effectively. Nowadays slow-release fertilizers are also in use to control the loss of nitrogen by the plants. Moreover, for the better development of plant more practices and improvement in the plant is needed to use nitrogen more effectively.

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