An Agricultural Pollutant: Chemical Fertilizer

Serpil Savci

***Abstract*—Consumer society, in order to meet the growing need for food, agricultural land per unit area required to achieve maximum efficiency and highest quality product. It is known that the nutrition of the plant is the one of the most important factors to control agricultural productivity and quality. Rates of nutrients in the soil affects the quality of yield. In the permanent agricultural land, the soil will be very poor in nutrients, as a result, inefficient. Therefore, producers, fertilize the soil, combat pests, irrigation and process of agricultural activities to make more efficient to soil. Fertilization among these activities remains a priority at all times. Recent studies, however, excessive use of fertilizers is the need for additional land outside the public and environmental health of the reported adverse affects. Excessive fertilization and mindless, but there were soil salinity, heavy metal accumulation, water eutrophication and accumulation of nitrate, to consider in terms of air pollution in the air of gases containing nitrogen and sulfur, giving and can lead to problems such as the greenhouse effect. In this review, aims to reveal environmental and health problems caused by improper fertilization provides recommendation toward solving these problems.**

***Index Terms*—Agricultural pollution, environment, fertilization**

I. Introduction

Fertilization increases efficiency and obtains better quality of product recovery in agricultural activities. It is one of the most important ways. Non-organic fertilizers mainly contain phosphate, nitrate, ammonium and potassium salts. Fertilizer industry is considered to be source of natural radionuclides and heavy metals as a potential source. It contains a large majority of the heavy metals like Hg, Cd, As, Pb, Cu, Ni, and Cu; natural radionuclide like ^{238}U, ^{232}Th, and ^{210}Po [1-2] . However, in recent years, fertilizer consumption increased exponentially throughout the world, causes serious environmental problems. Fertilization may affect the accumulation of heavy metals in soil and plant system. Plants absorb the fertilizers through the soil, they can enter the food chain. Thus, fertilization leads to water, soil and air pollution.

The use of chemical fertilizers in Turkey is lower than developed and many developing countries. Chemical fertilizer used per hectare in Turkey (N+P+K) are determined as 100.4. These values are 665.5 in the Netherlands; 624.8 in Egypt; 373.2 in Japan; 301.5 in China; 287.5 in Britain; 205.4 in Germany; 180.1 in France; 160.8 in the USA; 126.4 in Italy; 121.4 in India; 115.4 in Greece and 106.9 in Indonesia kg/ha respectively [1].

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For the next 30 years, more fertilizer will be used to obtain more products. Excessive use of chemical fertilizers in agriculture, resulting in a large number of environmental problems because some fertilizers contain heavy metals (eg. cadmium and chromium) and high concentrations of radionuclides. Later these fertilizers agro-ecosystem constitutes the main source of heavy metals and radionuclides in plants and some results in the accumulation of inorganic pollutants [3]. Greenhouses, aquaculture especially large amounts of chemical fertilizers used during the peak season, so dangerously polluted well water, especially water resources, crop production quantity and quality of product deteriorates. Problems caused by too much fertilizer:

The amount of nitrate may increase in drinking water and rivers as a result of high levels of nitrogen fertilizer use.

The amount of phosphate may increase in drinking water and rivers as a result of the transport of phosphorous fertilizer with the flow of surface.

High level of Nitrogen fertilizer used plants grown in soils. It consists of carcinogenic substances such as nitrosamines, especially plants such as lettuce and spinach leaves are eaten. There are harmful accumulation of NO_3 and NO_2 [2-3] .

II. Effects of Chemical Fertilizers on Water Pollution

Nowadays, human beings aware of harmful effects on the environment of the use of nitrogenous fertilizers. Nitrogen in agricultural areas reach the water environment by three ways: Drainage, leaching and flow.

Nitrate leaching particularly linked to agricultural practices such as fertilizing and cultivation. Irrigated agricultural land in some of the arid and semiarid regions, increased amounts of nitrate accumulation in the soil used and along with the evaporation of water. According to the conditions, nitrate accumulated leached in varying amounts. It reaches the depth of soil. In the soil, fertilizers converted to nitrate through nitrification by microorganisms. Due to negatively charged of nitrate can reach ground water. Even in ideal conditions, Plants use 50% of nitrogenous fertilizers applied to soil, 2-20% lost evaporation, 15-25% react organic compounds in the clay soil and the remaining 2-10% interfere surface and ground water [4-5]. The majority of nitrogenous fertilizers aren't absorbed products and they interfere with both underground and surface water. Groundwater nitrate problem should be considered in a global context. 22% of cultivated areas in Europe for the international recommended dirinking water nitrate concentration in graundwater concentration ($\geq$ 11.3 mg/L) above. In European Countries, NO_3-N concentration value is 23 mg/L and in the USA it is 45 mg/L. NO_3 and NH_4^+

concentration, Nottingham, United Kingdom exceeds the stated limits. The city of Nottingham is underlain by the unconfined Sherwood aquifer, which is vulnerable to contamination from various sources arising from urban and industrial activities of the region. According to that study, samples of aquifer recharge, both artifical and natural, and of shallow and deep groundwater were collected to determine the sources and level of contamination from nitrogen species. Deep groundwater contains low concentrations of ammonium (less than 0.3 mg-N/L) throughout, however much higher nitrate concentrations (less than 1.0 mg/N/L to 28.0 mg-N/L). Most remaining groundwater samples have a nitrogen fertiliser source, possibly derived from an influent river draining a rural catchment. In that study, groundwater quality is continuously monitored and isotopic measurements were made [6]. Similar high concentrations of NO_3 and NH_4^+ have also been reported in the USA. According to research carried out in wells used on farms in Ontario, Canada, approximately 14% of the wells were found to be over the limit values of NO_3-N concentration. In that study, four farm wells were chosen in each township where >50% of the land area was used for agricultural production. With in the practical constraints of the survey, it was considered that a total of between 1000 and 1500 wells could realistically be included in the study. Nitrate concentration was measured spectrophotometrically [7]. In Antalya region of Kumluca their study on the determination of nitrate concent of well water NO_3 2.46-164.91 mg/L is changing and the region of approximately 50% of nitrate pollution of well water was subjected stated. Water samples were taken from 20 wells in the region. The results obtained showed that the NO_3 content of the well waters in the region changed from 2.46 to 164.91 mg/L, NH_4 content from 2.35 to 7.22 mg/L, [NO_3-N]+ [NH_4-N] content from 2.84 to 40.02 mg/L. It was found that the NO_3 content of the 50% of the well waters were higher than 45 mg/L which was accepted as critical value for the NO_3 pollution in waters [8]. In Eskisehir, NO_3 pollution in their study report that under the alluvial aquifer. The water analyses from 51 wells and 9 sampling points on the Porsuk River, taken over a 2-year period, were used to examine the nitrate pollution in the groundwater. The average nitrate concentration in the groundwater of the study area was 40.0 mg/L; 34.2% of the nitrate concentration of the samples were above 45 mg/L the upper limit in drinking water standarts [9]. Their study related to the concentration of nitrate Demre, Antalya region of approximately 45% of well water that is allowed by the World Health Organization, 50 mg/L is above the limit value stated. In the same study at the begining of growing season with high concentration of NO_3 training period before the decline in again showed an increase after found that [10].

One of the most important parameters of the pollution of water is nitrate which is the basic component of fertilizer. Both the nitrate concentration of groundwater and surface water is increased by agricultural activities. Nitrate is the most common form of dissolved nitrogen in groundwater. However, It can be found in the form of nitrite (NO_2^-), nitrogen (N_2), nitrogen oxide (N_2O) and organic nitrogen.

Nitrates from drinking water of the body is absorbed in the intestinal tract 4-12h and is exceted by the kidneys. The mechanism, as well as the salivary glands can concentrate nitrate. As a result, the mouth is reduced to nitrite in the anaerobic environment.

It is possible to examine the toxicological effects of nitrate in three stages. The primary toxic effect of nitrate concentrations in drinking water of 50 mg NO_3^-/L exceeds the value of the bowel in adults, digestive and urinary systems, inflammation is seen. Seconder toxicity, high nitrate concentration in drinking water caused digease in infants methamoglobianemi. Stomach acid does not occur in infants younger than six months. In this environment, nitrate nitrite reacts with hemoglobin in the blood is minimized methamoglobin consists of nitrite in the digestive system. Meanwhile, iron contained in hemoglobin and blood oxygen transport function lost. As a result, infants are found stragled to death. Advancing age, it is eliminated as a result of the increase in stomach acids. Toxicity in acid medium of secondary and tertiary amines tertiory nitrites, alkyl ammonium bases and react accordingly amides occurs a s a result nitrosamines occurs, as a result of this and nitrosomines. Strong carcinogenic effects of these compound has been identified in recent studies. One of the most important negative effects of intensive fertilizer use is water eutrophication. Increased amounts of nitrogen and phosphorous compounds in water as a result of the increase in the amount of higher aquatic plants and algae formation and degradation of water quality and water environment in the event of life is defined as eutrophication. Eutrophication in the bottom layer, oxygen-free environment as a result, not suitable for drinking and water supply, reduction in the number of living species in the aquatic environment fish kills, proliferation of unwanted species, odor problem, the media appear to be unsuitable for recreation [5-11].

III. Effects of Chemical Fertilizers on Soil Pollution

According to the researces and studies the effects of chemical fertilizers on the soil is not immediately obvious. Because soils have strong buffering power due to their components. Over the time, it states that emerged from the pollution, deterioration of soil fertility, soil degradation reactions occuring in the soil leads to deterioration of the balance of the current element. In addition, toxic substances accumulate within the vegetables and causing negative effects in humans and animals are fed.

Soil structure in agricultural productivity are very important and it is regarded as an indicator. Unconsciously, the fertilizing, soil, just as in the deterioration of the structure is caused by industrial emissions. Especially $NaNo_3$, NH_4NO_3, KCI, K_2SO_4, NH_4Cl demolish the structure, such as fertilizers, soil, soil structure, deterioration is difficult to obtain high-quality and efficient product.

Particularly high level of sodium and potassium containing fertilizers, make a negative impact on soil, pH, soil structure deterioration and the increasing feature of acid irrigation or other agricultural operations or from the benefits derived from it is not possible or very scarce. Continuous use of acid-forming nitrogen fertilizers causes a

decrease in soil pH, liming, if not carried to prevent the declining efficiency of field crops. Basic use of fertilizers in the soil leads to an increase in pH. Increaeses in soil and plants, seedlings pH circuit of a sudden drop in the yield and quality drops, but causes harmfulness. In addition expanding the size of soil pollution by accumulation in the soil.

Research in the province of Rize in the territory of our country, one-way ammonium sulfate fertilization of tea, actually led to an increase in acidity of soils with low pH. Today 85% of the territory has dropped below pH 4 which is considered as the critical level. In Nevsehir over the last twenty-five years as a result of nitrogen fertilization of potatoes grown in 100-fold increased acidity of the soil pH has fallen to 2. Granting the land, excessive nitrogen fertilizers Rhizobium sp. activites, such as symbiotic nitrogen fixing microorganisms is negatively affected. In this case, the part of the air plugs to benefit from the free nitro. In addition, more nitrogenous fertilizers limit the activities of nitrifying bacteria. Thus, the cost of the second nitrogen source is damaged [12]

Given large amounts of potassium fertilizers in the soil of Ca and Fe with Zn disrupt the balance of nutrients by the plants and prevent the receipt. However, the negative effects on organisms, given the variety of worms and soil mite has been devastating and lethal effect.

IV. Effects of Chemical Fertilizers on Air Pollution

It is known to be one of the most important inputs of fertilizers in agricultural production. When it is applied inadequate, rates of productivity and quality are caused significant losses. When it is too much applied, it causes air pollution by nitrogen oxides (NO, N_2O, NO_2) emissions. Nowadays, there are some gases in the atmosphere. Their names are water vapor, carbon dioxide, methane, hydrogen sulfide (H_2S) with chloro-fluoro hydrocarbons, such as halon gases associated with these compounds. Also there are some gases on lower layers of tropospheric ozone. These gases contribution to the greenhouses effect. As a global, atmospheric N_2O increases from 0.2 to 0.3% each year. Also in case of excessive use of nitrogenous fertilizers, especially nitrate content of levels of the plant would threaten human health level reaches the leaf vegetables eaten [13].

Calcareous and alkaline soils, especially applied to the soil surface structure and ammonium fertilizers with urea, can result in evaporation of NH_3. Evaporation of ammonia, a large number of soil and environmental factors can be controlled and directly proportional to the concentration of ammonia in the soil solution.

Ammonia emmision from fertilized lands, adjacent to result in depositing on ecosystems and vegetation damage. NH_3 may be oxidized and turn into nitric acid, sulfuric acid from industrial sources, create acid rain after the chemical transformations. Acid rain can damage vegetation. Also, it can damage organisms that they live in both lakes and reservoirs [14].

V. Conclusion

Today, use of fertilizers is seen as a necessary agricultural technology. Because soil restores nutrients. However, firstly soil analysis should be performed carefully. After then, fertilizer should be given to soil. The structure and chemical content of the soil should be identified and the most appropriate type of fertilizers should be selected. The most suitable method should be processed. Otherwise, the fertilizer should be noted that errors will result in the loss of both energy and finance. Fertilizing should be done in time, should not be inappropriate times. For example a heavy rainfall to the seasons, fertilization, fertilizers water will mix with the surrounding soil by leaching. For this reason, fertilizer will be lost from soil, as well as pollution of surrounding water and therefore it will result in eutrophication [1]. Water caused by chemical fertilizers is the most effective way to prevent eutrophication, especially in the form of phosphorus flow will stop. In addition, sedimentation, nutrients, dilution, pressure water application, filtration, water algasit or herbicides, such as the addition of some physical and chemical methods can be effective [15-16].

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