1. INTRODUCTION

The agricultural organic and plant residues are considered as a wasted national wealth, where they are badly used. Instead of good utilization, the farmers get ride of it by burnt causative the black cloud covered the sky of Egypt. Also, water hyacinth plants covered a great area of River Nile and its branches and consumptive a great amounts of water sources.

Recently, on the way of clean agriculture, the world trend goes toward using and recycling plant and organic residues to produce the organic fertilizers which is very important for increasing the agricultural production, reducing the application rates of chemical fertilizers and therefore, the prevention of environmental pollution which affect public health.

Soils in arid and semi-arid environments are generally low in their organic matter contents because the very rapid rate of wastes or residues decomposition by the microflora following irrigation or precipitation. Also, temperature in arid climates are usually considerably higher than those of humid-temperate climates. Neverseless, the proper applied to land is one of the best means for protecting agricultural soil against degradation processes.

These organic materials can markedly increase soil productivity by providing essential plant nutrients and by improving soil physical and chemical properties. However, the organic matter content in Egyptian soils gradually decreased and in order to increase it, the use of different sources of organic residues became necessary.

Soil organic matter is usually less than 10 percent of the total weight of mineral soils. Therefore, to actually change the organic matter content of a soil, very large amounts of organic materials must be applied. Also, soil conditioners vary greatly in their composition, application rate and expected or claimed mode of action, where better chemical incorporation better root development and higher yields and quality.

The fast growing of aquatic water hyacinth (*Eichhornia crassipes*) necessitate the need to utilize this source of biomass. Managing the weed is subject of serious concern in many countries like Egypt. Few studies in Egypt were done about the using of water hyacinth as a fertilizer or amendment.

The objective of the present work is to find out the effect and residual effects of applying some natural organic residues as compost i.e. water hyacinth compost, rice straw compost and farmyard manure on some soil physical, hydrophysical and chemical properties, availability of macro and micronutrients and heavy metals besides the changes in chemical composition in plants (grains and seeds) and productivity of maize and flax quality and quantity. Also, the whole improvement of such soils are economically determined by calculating the net income and investment ratios for all experimental treatments. A computer model will be utilized to assess the immediate and residual effects of the different amendments on both the soil properties and the characters of the growing plants.

2. REVIEW OF LITERATURE

2.1 Preparation of compost:

Gotaas, (1956) reported that, there are two processes of composting (a) Aerobic decomposition and stabilization which mainly depend on much of the carbon serves as a source of energy for the organisms which burned up and respired as CO_2. A great deal of energy is released in the form of heat throughout the oxidation of carbon to CO_2. (b) Anaerobic fermentation (putrefactive breakdown of organic materials) and transformation of the organic nitrogen to organic acids and ammonia. The carbon is liberated mainly in the reduced form of methane and no heat is released in anaerobic fermentation.

Haggag (1994) found that the composted cotton stalks of fine size (less than 2cm) had a significant positive effect on physiochemical properties, bulk density, NPK, EC except pH which was decreased with the fine compost than with the coarse one, 2-10 cm. Further, ***Estefanous et al. (1996)*** studied two composted agricultural residues, maize stalks and rice straw, mixed with biogas slurry. They found that pH of the two composts was close neutrality or slightly alkaline which is suitable to Egyptian soils. It was also in the range suitable for plant growth; their pH was in the range of 7.20 and 7.30.

Ali, Laila (2001) studied the possibility of composting cotton and rice plant residues. Both cotton stalks and rice straw were composted after cutting to small pieces and arranging into equal layers to enhance the aeration and decomposition process, to active the rate of decomposition process, an activator mixture of 15 kg ammonium sulfate, rock phosphate and, mature farmyard manure were added to the composting materials.

Wong et al. (2001) evaluated the feasibility of composting soybean residues and leaves and the effect of turning frequency on compost quality. Soybean residues were mixed with leaves and sawdust at ratio of 1: 1:3 by weight for achieving a C/N ratio of about 30. Three heaps of 4 m^3 of compost mixture were prepared. The heaps were turned and composted for 63 days. The moisture content was adjusted to about 60-70% at the beginning of composting and then periodically during the composting period.

Radwan and Awad (2002) prepared the compost of the plant materials, rice straw, maize stalks and water hyacinth, which were airdried, sieved to pass through 2mm sieve and moistened to 70% of their water holding capacity, each plant material was composted in association with a chemical accelerator (7kg superphosphate, 40kg ammonium sulphate and 35kg calcium carbonate and 100kg fertile soil per ton dry matter) and were turned off every two weeks, untile its maturity.

Kenawy, Mona (2003) prepared compost by using some plant agricultural wastes namely, chopped rice straw, grounded peanut shells and olive cake. Two heaps of compost were made from mixture of chapped rice straw, grounded peanut shells and olive cake at ratio of 2: 1: 1 by weight with 5% rock phosphate and 5% Mn-dust. One of the heaps was pre-treated with 5% sulphuric acid and the other untreated. Both treated and untreated heaps were composted for 30 days and received 2% urea + 10% bentonit + 5% farmyard manure and aerobically composted for 90 days.

Ganesh et al. (2011) prepared compost from water hyacinth, cattle (Cow) manure and saw dust where used four proportions of different waste mixtures. The compost was prepared with different proportions of waster compostion from water hyacinth, cattle manure and saw dust have performed on pile composting of water hyacinth in combination with cattle manure and saw dust as a bulking agent, all waste combinations was formed into trapezoidal piles length 2.10m, base width 3.50m. top width 1m. and height 2.50m and were turned off every 3 days.

Das and Kalamdhad (2011) prepared compost from water hyacinth, cattle (cow) manure, saw dust and rice straw and were formed into trapezoidal piles, length 21.00m, base width 3.50m, top width 1.00m and height 2.50m having length to base width (L/W) ratio of 6. Also, agitated piles contained approxdimately 100 kg of different waste combinations and were manually turned every 3 days.

2.2 Some changes happened during composting processes:

2.2.1 Moisture content:

The optimum moisture content of ingredients for composting was to be 50-60% ***Mathur et al. (1993)*** they added that the maximum practical moisture content depends on the structure-wet strength of the materials such as paper collapse readily on composition, the pore fill with water to cause anaerobic conditions, stiff materials, such as straw and twigs, retain their wet strength for along time and can be composted at high moisture contents.

Abou EI-Naga *et al* (1997) showed that the moisture content in the organic materials (farm residues, village wastes and urban wastes) were maintained around 60 to 65% of the water holding capacity (WHC) over the period of composting. The losses of water due to evaporation were corrected by the addition of equivalent amounts of water. In addition to that, ***EI-Halwagi et al.*** **(1998)** explained that the composting process becomes inhibited as the moisture content nears to 40%. At moisture levels above 65%, water displaces much of the air in the pore species of the composting materials.

2.2.2 Temperature:

During the composting process in compost heaps or windrows, the temperature evaluation is considered to be a reflection of the metabolic activity of the microbial populations involved in the process ***(Finstein and Morris, 1975)***. ***Stickeberger (1975)*** stated that the compost is matured enough when its temperature remains more or less constant and does not vary with the turning-over of the material.

Harada et al. (1981) found that the temperature in the compost heap increases during the first few days, remains between 50 and 70°C for several days and then decreases gradually to a constant temperature. Consequently, this parameter may be considered as a good indicator for the end of the bio-oxidative phase in which the compost achieves some degree of maturity.

Hanafy et al. (1990) indicated that the temperature inside the heap was higher than that in the subsurface. At 40 and 60 cm under the surface, the temperature was raised to 44 and 46°C, respectively after 3 days and reached to 59°C on the 12^{th} day. On the other hand, the surface temperature was gradually raised to reach 48°C on the 12^{th} day.

Harada (1992) indicated that the rise and fall in temperature and changes in constituent of compost reflect the maturity process. A temperature of 55-60°C held for at lest 3 days, is necessary to kill all weed seeds and disease causing by organisms (pathogens) ***(Mathur et al., 1993).***

Temperature is an important change in the biology of a compost heap. The breakdown of composting materials by microorganisms caused rising in temperature of heap ***(Kriesel et al., 1994 and Probert et al., 1995).***

Churchill et al. (1996) explained that, during composting the internal temperature of the composted straw was increased, this indicated that moisture, oxygen and nutrient availability were favorable for thermophilic microorganism activity. A higher temperature during composting is desirable to kill weed seeds and pests that could contaminate subsequent crops.

Mathur et al. (1993) and Abou El-Naga et al. (1997) observed that the temperature rise in both middle and bottom of the compost heaps and being low at the surface. They added that the thermophilic stage started after 7 days and lasted for almost a month, then it gradually falls down to the ambient temperature. The farm residues showed that the highest temperature was followed by the village and urban wastes.

Abd El-Wahab (1999) found that the temperature inside the compost heaps reached maximum within 2 to 4 days after each heap turning. Its values were declined to reach minimum values at each interval. Moreover, the temperature values were higher at the deep layers of the heaps (45 cm) than near the surface (15 cm).

Khalil et al. (2001) found that the temperature attained to 50-65°C and may even reach 80°C in well aerated windrows compost built up of municipal soil waste because of the active role of microorganisms under these preferable cases.

Tang et al. (2006) found the circumstances of aerobic, thermophilic composting, since they found that, the temperature usually rises to over 50^{o}C during the process and the maxiumum desirable composting temperature is considered to be 60^{o}C, based on microbial species diversity and the rate of decomposition. They also added that the temperature rise is important for public health as pathogens in compost are destroyed during the thermophilic composting process.

Umsakul et al. (2010) investigated the physical, chemical and microbial population changes that occurred during the composting of water hyacinth. The results showed that the pH was 7 and the highest temperature reached of $40^{o}C$ occurred in the first week.

Das and Kalamdhad (2011) found that the variation in temperature of composting materials with time is higher temperature, 59.4 and $57.3^{o}C$, respectively and entered into thermophilic phase after one day indicating quick establishment of microbial activities in the pile.

2.2.3 pH:

Moharram et al. (1989) found that initial values of pH at the beginning of composting ranged between 6.85 and 7.30, during the composting process, the pH values showed a slight decrease toward slight acidity. At the end of the experiment, pH values tended to increase to neutral and this was attributed to releasing of H^{+} ions from organic acids during the composting process. The pH values play an important role in the activity of microorganisms responsible for decomposition process.

Dickson et al. (1991) indicated that pH between 5.5 and 8.5 is optimal for compost microorganisms. As bacteria and fungi digest organic matter, they release organic acids. In the early stags of composting, these acids often accumulates. The resulting drop in pH encourages the growth of fungi and the breakdown of lignin and cellulose. Usually the organic acids become further broken down during the composting process, if the system becomes anaerobic, however, acids accumulation can lower the pH to 4.5, severely limiting microbial activity. In such cases, aeration usually is sufficient to return the compost pH to acceptable ranges.

Chaney (1992) found that composting materials become slightly acidic at the start of composting as the initial products of break down are simple organic acids.

Mathur et al. (1993) found that the heap turns slightly alkaline after few days as proteins are attacked by organisms and ammonia is released. Highly alkaline conditions will lead to excessive loss of nitrogen as ammonia. In contrast, highly acid initial conditions of the heap may lead to warming up.

Abou EI-Naga et al. (1997) found a slight decrease in the pH values 6.5 in the first week and 6.2 in the second week and then they gradually turned to their neutral level which was higher in the case of farm residues compared with urban wastes.

Elvira et al. (1998) reported that vermi composting process appreciably modified the properties of the different substrates. The lower pH was recorded in the final products which might have been due to the production of CO_2 and organic acids by microbial activity during the process,

Abd El-Wahab (1999) reported that the values of pH were slightly decreased in early intervals of composting process then the pH values increased significantly afterwards to reach up neutral value.

Wong et al. (2001) studied the co-composting of soybean residues and leaves and the effects of turning frequency in compost quality. They found that the changes in pH for the different piles followed the same trend with a slight decrease from the range of 6.1-6.8 to 5.3-6.1 in the first 7 days. This was due to the decomposition of organic matter and production of organic acids by the activities of microorganisms in soybean residues and leaves. The pH value was then increased significantly to about 8.2 after 14 days. This response may be explained by ammonification and mineralization of organic nitrogen through microbial activities. After 35 days, a gradual decrease in pH was observed. This slight decline may be due to the volatilization of ammonium and release of hydrogen ions from the nitrification process later in composting periods by nitrifying bacteria. The same trend was obtained by ***Deng et al. (2004).***

2.2.4 C/N ratio:

Chanyasak and Kubota (1981) reported that the C/N ratios of sufficiently well composted materials vary widely from 50 to 20 depending on the type of raw materials.

Hiria et al. (1983) showed that although the C/N ratio of solid phase can not be used as an absolute indicator of compost maturation due to large variation that is dependent on the starting materials, a value round or below 20 could be considered satisfactory.

It has been stated that when the C/N ratio is less that 20, the compost is mature and can be used without any restrictions ***(Jimenez and Garcia, 1989).***

Dickson et al. (1991) reported that many elements are required for microbial decomposition, carbon and nitrogen are the most important elements provide both energy source and basic building block making up about 50 percent of the mass of microbial cells. Nitrogen is a crucial component of the proteins, nucleic acids, amino acids, and enzymes necessary for cell growth and function. To provide optimal amounts of these two crucial elements, can use the carbon to nitrogen C/N ratio for each of compost ingredients. The ideal C/N ratio for composting is generally considered to be arranged 30:1. At lower ratios, nitrogen will be supplied in excess and will be lost as ammonia gas, causing undesirable odors, higher ratio mean that there is not sufficient nitrogen for optimal growth of the microbial populations, so the compost will remain relatively cool and degradation will be proceeded at a low rate.

The organic matter decreased as a result of the microbial activities on the composted material, The rate of decrease was rapid during the first week of composting and the compost could be considered as good organic fertilizer if it had more than 30% organic matter ***Estefanous et al. (1996)*** in addition to that, the C/N ratio in compost depended on the C/N ratio of the initial materials, but it varies along the stabilization process.

Churchill et al. (1996) defined that the decomposition of high C/N plant residues depends on the production of microbial by-products and stabilization of plant-derived substances. The final product is potentially valuable as an organic amendment that can improve soil quality, beyond its value as a nutrient source.

Abou EI-Naga et al. (1997) showed that the C/N ratio of the composted wastes has been reduced towards maturity stage and reached values of 18.1, 17.6 and 22.1 for farm residues, villages wastes and urban wastes, respectively. This narrowing of the C/N ratio is an important measure for stability of compost.

Shen et al. (1997) investigated the changes in biochemical characteristics of organic manure compost using labeled organic and inorganic materials. The results indicated that the best combination of decomposition rates among the different organic materials was seen with rice straw and chicken manure. During the composting process total C and C/N ratio were decreased but the nitrogen content was increased.

Vurinen and Sahrunen (1997) found that C/N ratio was decreased from 22.6 -28.5 to 12.7-13.6 during composting of dries cattle and swine manure mixed with barley straw.

El-Halwagi et al. (1998) explained that the raw materials blended to provide C/N ratios of 25: 1 to 30: 1 are ideal for active composting. An initial C/N ratio from 20: 1 up to 40: 1 consistently give good composting results. The excess nitrogen may then be lost to the atmosphere as ammonia or nitrous oxides and odor can become a problem. Mixture of materials with C/N ratios higher the 40: 1 requires longer composting times for the microorganisms to use the excess carbon.

Khalil et al. (2001) recorded that C/N ratio is one of the main characteristics that describe the composting process. It is often used as an index of composting maturity, despite many pitfalls associated with this approach, but it seems to be a reliable parameter for following the development of the composting process.

Wong et al. (2001) stated that the C/N ratio was decreased with the progress in the composting process of soybean residues, leaves and sawdust in I: 1: 3, by weight, The values were diminished during composting process from about 30 at the beginning to 18-22 at the final.

Paredes et al. (2002) reported that the C/N ratio fell mainly during the bio-oxidative steps of maize straw or cotton waste composting with olive mill waste water sludge as a result to reduce C concentration due to organic matter degradation.