THE EFFECT OF ORGANIC FERTILIZERS ON GROWTH AND YIELD OF SWEET BELL PEPPER (*Capsicum annum* L.)

Bestan Hassan AFANDI

MASTER THESIS

Department of Soil Science and Plant Nutrition

Supervisor: Assoc. Prof. Dr. Ali Rıza DEMIRKIRAN

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REPUBLIC OF TURKEY
BİNGÖL UNIVERSITY
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This dissertation was accepted by the following committee on 17.01.2017 with the vote unity

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Director of Institute of Science

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Dedication

I dedicate this work to my mother and to spirit my Dear father.

Bestan Hassan AFANDI

Bingöl 2017

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LIST OF SYMBOLS

D.W	: Distilled water
pH	: Potential of Hydrogen
EC	: Electrical Conductivity
OM	: Organic Matter
$CaCO_3$	: Calcium Carbonate
N	: Nitrogen
P	: Phosphorus
K	: Potassium
mm	: Mille meter
m	: Meter
cm	: Centimeter
g	: Gram
kg	: Kilogram
ha	: Hectare
t	: Ton
ppm	: Part Per Million
%	: Percentage
°C	: Degree Celsius
HNO_3	: Nitric acid

HCl	: Hydrochloric acid
NaOH	: Sodium hydroxide
H_2SO_4	: Sulfuric acid

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ORGANİK GÜBRELERİN TATLI BİBER'İN (*Capsicum annuum* L.) VERİMİ VE GELİŞMESİ ÜZERİNE ETKİLERİ

ÖZET

Bu deneme 2016 yılı 23 Nisan-16 Temmuz tarihlerinde Ira-Sülemaniye-Bazian'da Tarımsal Araştırma Enstitüsü bünyesinde, tatlı biberin (*Capsicum annum* L.) (Flavio F1) sera koşullarında gelişme ve verimi üzerine organik gübrelerin etkisi araştırma amaçlı yürütülmüştür. Biber fideleri ihtiyaca göre sulanmıştır Denemede siltli kil tekstürlü toprak Faktöriyel deneme desenine göre kullanılmıştır. Faktör olarak, 3 çeşit organik gübrenin (kümes hayvanı atığı, büyükbaş atığı ve kompost) kontrol ile birlikte 30 ve 60 t ha^{-1} olarak uygulanmıştır.

Vejetatif parametreler olarak; bitki boyu, yaprak sayısı (şaşırtmadan sonra), %50 çiçeklenme tarihi, çiçeklenme süresinde yaprak N, P ve K konsantrasyonu, gövde çapı, toprak üstü aksamı ağırlığı (yaş ve kuru), kök ağırlığı (yaş ve kuru) ve dal sayısı incelenmiştir. Hasat, yaş ve kuru meyve ağırlığı, meyve uzunluğu ve çapı parametreleri alınarak yapılmıştır. Ayrıca toprakta N, P, K, $CaCO_3$ konsantrasyonu, EC ve pH düzeyleri belirlenmiştir. Kümes hayvanı atığının 30 t ha^{-1} uygulaması önemli ölçüde bitki boyu, yaprak sayısı toprak üstü aksamı kuru ağırlığı, kök taze ağırlığı, gövde çapı, taze meyve ağırlığı ve kuru meyve ağırlığını arttırmıştır. Bu değerler sırasıyla; 24,4 cm $bitki^{-1}$, 57,20 adet $bitki^{-1}$, toprak üstü aksamı ağırlığı 38,38 g $bitki^{-1}$, kök taze ağırlığı 37,27 g $bitki^{-1}$, gövde çapı 10,67 mm $bitki^{-1}$, meyve taze ağırlığı ikinci hasatta 73,63 g $bitki^{-1}$ ile üçüncü hasatta 95,77 g $bitki^{-1}$, meyve kuru ağırlığı, ikinci hasatta 5,04 g $bitki^{-1}$ ile 9,29 g $bitki^{-1}$ olarak, üçüncü hasatta meyve sayısı ise 2,67 adet $bitki^{-1}$ olarak elde edilmiştir ($p<0,05$, $p<0,01$ ve $p<0,001$).

Kümes hayvanları atığının 60 t ha^{-1} uygulamasında P, K, O.M. ve EC düzeyleri sırasıyla %0.221, 24 mg kg^{-1}, %3,20 ve 0,41 ms cm^{-1} olarak elde edilmiştir $p<0,01$ ve . $p<0,001$ Organik gübrelerin 60 t ha^{-1} uygulanması neticesinde yaprak N, P ve K içeriği %1,73, %0,118 ve %0,12 sırasıyla önemli olduğu belirlenmiştir ($p<0,05$ ve $p<0,01$). Buna karşın 30 t ha^{-1} uygulamasında bu içeriklerin en düşük düzeyde olduğu belirlenmiştir. Bu sonuçlar göstermiştir ki, kümes hayvanları atığının düşük ve yüksek düzeyde uygulamaları incelenen çoğu faktörleri önemli ölçüde etkilemiş olup, büyükbaş hayvan atığı ve kompost uygulamalarının ise etkili olmadığı belirlenmiştir.

Anahtar kelimeler: Kümes hayvanları atığı, büyükbaş hayvanların atığı, kompost, tatlı biber, (*Capsicum annum* L.) ve makro elementler.

THE EFFECT OF ORGANIC FERTILIZERS ON GROWTH AND YIELD OF SWEET BELL PEPPER (*Capsicum annum* L.)

ABSTRACT

This experiment was carried out from April 23th–July 16th 2016 in a Directorate of Agricultural Research in Iraq–Sulaymaniyah–Bazian to study the effect of organic fertilizers on growth and yield of sweet bell pepper (*Capsicum annum* L.) (Flavio F1), in a greenhouse and in pots. Peppers were irrigated manually immediately after transplanting. Factorial randomized complete design (CRD) was used in silty clay loam soil. Two factors tested; three types of organic fertilizers (poultry, cattle and compost manure) with control and two doses of manures (30 and 60 t ha^{-1}).

Vegetative parameters were measured such as; plant high and number of leaves week after transplanting until ten weeks, 50% flowering date, determine leaf N,P and K concentration at flowering stage, stem diameter, shoot (fresh and dry) weight, root (fresh and dry) weight, branches number. Harvest until three picks for all treatments and then measured fruit fresh and dry weight, fruit number, fruit length and diameter. After third pick for any treatments determine N, P, K, $CaCO_3$ concentration EC and pH in the soil. Poultry manure 30 t ha^{-1} application increased significantly and recorded highest result for plant height, leaves number, shoot dry and root fresh weight, stem diameter, fresh fruit weight and fruit dry matter (second and third pick) and fruit number (third pick) 24.4 cm $plant^{-1}$, 57.20 $plant^{-1}$, 38.38 and 37.27 g $plant^{-1}$, 10.67 mm $plant^{-1}$, (73.63 and 95.77 g $plant^{-1}$) and (5.04 and 9.29 g $plant^{-1}$) and 2.67 $plant^{-1}$ respectively (at $prob<0.05$, $prob<0.01$ and $prob<0.001$).

Poultry manure 60 t ha^{-1} application recorded highest P, K, O.M. concentration and EC, 0.221%, 24 mg kg^{-1}, 3.20% and 0.41 ms cm^{-1} respectively (at $prob<0.01$ and $prob<0.001$). The applications of fertilizers 60 t ha^{-1} effect on increase leave N, P and K concentration at flowering stage significantly 1.73%, 0.118% and 0.12% at $prob<0.05$ and $prop<0.01$ respectively; while decrease with application 30 t ha^{-1} and control recorded lowest concentration. These data showed that poultry manure with low and high application was affected for many results; while cattle and compost manure was affected significantly.

Keywords: Poultry manure, Cattle manure, Compost manure, Sweet bell pepper (*Capsicum annum* L.) and Macro elements.

1. INTRODUCTION

In the last 75 years, several of researches have done to impose a question of if adding or rather mixing farming chemicals and further agricultural techniques as well as organic or natural farming would influence the nutrient substance or not (Ghoname and Shafeek 2005). Adding compost is a very essential and valuable technique for creating a steady crop in which it can be storage and has slight smell (Sweeten 1988). Natural growing improved and enlarged the rate of antioxidant compounds, for example, carotenoids, phenolic compounds and vitamin C in sweet pepper. Natural fruits and vegetables are superficial since they have upper dietary and substance in terms of biological mixture (Hallmann and Rembialkowska 2012).

Natural compost function endorsement soil fertility and crop manufacturing are surely predicted to advance the soil biodiversity and leading the ecology and the environment to be more powerful towards pressure and anxiety (Liu et al. 2016). If carbon used to a low unrefined subject or even to corrode soil, it is more important and influential than the nourishing which includes in the food (Eghball and Power 1999). High rate of salt could cause phytotoxicity issues and hence, electrical conductivity is a suitable pointer which reveals the salinity of natural adjustment and appropriateness and secure manure for agricultural intentions (Villar et al. 1993).

The work of essential nourishing of livestock of bird and hen differs with the sort of the bird, the portion of nourishing, the quantity of litter to compost and dung, and the sort of litter. Hence, all of the compost must be examined and evaluated for detailed and précised nutrient substance before you imply them practically. The value of poultry manure varies not only with its nutrient composition and availability, but also with management and handling costs. The worth of poultry manure differs not solely in terms of nutrient accessibility but also in terms of organization and behavior expenses (Zublena et al. 1997). The possibility for pollution of land and surface waters by inappropriate managing and discarding of animal compost from the livestock area is very huge since most of the feedlots have rather little land space and the cost of shipping is very high (Chang et al. 1998).

The continuing impacts of useful compost on soil land actually enhance compost management to promote the agricultural creation and the surrounding involves a careful and detailed consideration (Hao et al. 2003). The continuous fertilization test in Darmstadt was created to evaluate the outcome of animal fertilization compared to the manure farmyard cattle implementation by means of or even without biodynamic training on the excellence of soil and yield (Abele 1987). The civic manure can be valuable to the soil situation and to the sluggish liberate nutrient supply which was exposed and illustrated by the International research (Sullivan et al. 2002; Sullivan et al. 2003 and Hargreaves et al. 2008).

The issues of ecology related with the handling of compost by converting it to more secure and balanced subject which is more appropriate to the implementation of soil. Hence, it will diminish steadiness (Carr et al. 1995). Manure and yield have the possibility to diminish soil corrosion, enhancing the superiority of soil, develop managing and handling crop harvest (Power 1987; Stute and Posner 1993; Teasdale 1996). Cattle manure compost which offers high filling of micro and macro nutrients for yield expansion and it is quite economical to compost and nourishment since it is very precious foundation as a soil stimulant (Hutchison et al. 2005). Cattle manure is created in big measurements in manufacturing breeding amenities and the distribution of this squander on land could trigger pollution of the environment, water, and the soil (Lazcano et al. 2008).

Fertilization with cattle manure is an essential and crucial resource for enhancing soil richness under certain conditions (Maeder et al. 2002). Increases in the demand for poultry products have led to rapid and concentrated growth of the industry, which has caused excessive manure supplies in certain areas. Although poultry litter is one of the best organic fertilizers available. By applying best management practices (BMPs), we can prohibit bad and unpleasant effects resulting by soil application of hen and bird (livestock) compost, Poultry litter is commonly measured as the most precious of animal compost as a nourishment since it has huge quantities of N, P, k as well as minor, and trace basics, and to its small quantity of water substances in it. Before or during tillage pplication of poultry manure will reduce surface soil accumulation of added N and P and increase their distribution in the root zone (Moore et al. 1995).

There are other advantageous for the litter which adds to the macronutrients such as raising the soil pH, water handling ability. As we mentioned earlier, Poultry waste gives the usual macronutrient such as N, P, and K which is essential for the plants (Risse et al. 2006). Even though poultry industry is still one of the finest natural manure exist, Fast and intense expansion of the fowl animal business in most courtiers have also raised the anxiety about arranging fowl animal litter. It appears to be suggested to divide the N quantity in more usage to guarantee a balanced N contributor or provider for the plants. Green 1st class fruits were ripe in about 6.5 weeks and red fruits in about 9.5 weeks (Wilkinson 1997).

A high solar irradiation (summer) shortened the time from fruit setting to harvest and fruits matured earlier compared to fruits grown at lower solar irradiation. Pest in July and August delayed ripening (Stadler 2011). (Awad et al. 2002) stated that organic manure contains high levels of relatively available nutrients elements, which are essentially required for plant growth; moreover it plays an important role for improving soil physical properties.

The manufacturing uprising chased by green revolution triggered rising in giving away areas in farming growth. The industrial uprising caused rising in artificial manure and insect killer were applied in farming and crop growing. Since they were artificial, they caused so many issues related to health due to its microbial growth and causing contamination to its surroundings. Nowadays, new systems have created to cover these synthetic problems related to health issues, thus, they have developed organic agriculture, environmental agriculture, or persistent agriculture (Aksoy 2001; Chowdhury 2004).

2. LITERATURE REVIEW

2.1. Sweet Bell Pepper

Sweet bell peppers (*Capsicum annuum* L.) are a member of the Solanaceae family and originated in Central America and Mexico so it was used by early inhabitants as many as 12,000 years ago (USDA 2008a). Bell pepper is a very important fruit vegetable in the tropics and became second most important vegetable after tomatoes (Olaniyi and Ojetayo 2010).

Anyway, pepper in general used as a spice in the preparation of stew and soup (Adesina et al. 2014). Pepper contains vitamins and both the macro and micro nutrient elements which can supply the body with necessary components for growth (Olaofe et al. 1993; Alabi 2006). The amount of vitamin C in pepper is greater than tomato (Agusiobo 1976; Keshinro and Ketiku 1983). Additionally organically-grown peppers may provide consumers with greater health benefits than conventionally grown bell peppers due to greater levels of antioxidants (Hallmann and Rembialkowska, 2012). Sweet bell pepper is containing high amount of macronutrients in the middle of growth but it's become low at the end (Stadler 2011).

2.2. Organic Fertilizers

There is an increasing interest in the worldwide for using organic fertilizers as a track to decrease soil fertility and reduce costs of chemical fertilizers (Delate and Camberdella 2004; Farhad et al. 2009). Organic fertilizers are necessary for suitable growth for plant, flower and fruit. In addition, contain essentially nutrients for better developments (Silva et al., 2012).

Poultry or compost manure as a recommended rate of nitrogen are sustain soil fertility and reduce environmental pollution caused by application of chemical fertilizers on bell pepper (Shahein et al. 2015). Application of poultry manure caused to lower disease incidence high healthy as shown by 80% on tomato, compared with the other fertilizers; while application of organic fertilizers did not give higher yields compared with chemical fertilizers (Ghorbani et al. 2008).

2.3. Advantages of Organic Fertilizers

Now in the world many farmers using organic fertilizers and increasingly it is used year after year because they have several advantages unlike chemical fertilizers, as follows:

1- It does not contain toxic chemicals and harmful, so who eat organic products offered less for many skin diseases and cancer, etc., as opposed to those who eat chemical products.

2- Can produce locally or in the same field, so their cost is much less than chemical fertilizers, and therefore needs to workers and the area is less than the production of chemical fertilizers.

3- Organic fertilizers helps maintain soil structure and increase the holding capacity of nutrients, thus increasing soil fertility, so the farmer ensures that his field is rich in essential nutrients for hundreds of years.

4- Organic fertilizers easy biodegradation so it does not cause environmental pollution, unlike chemical fertilizers, which pollute water and soil, and this, causes many diseases, not only for humans but also for plants, animals and insects.

5- Because organic fertilizers produced locally especially in rural areas, this increase job opportunities, unlike chemical fertilizer that is produced in large automatic coefficient, which does not need many working hands.

2.4. Disadvantages of Organic Fertilizers

Organic manures have some disadvantages (Eghball et al. 1997) as following:

1- During composting loss nutrient and carbon.

2- The cost of land, equipment and labor required for composting.

3- Odor associated with composting.

4- High level of some elements in organic fertilizers.

2.5. Effect of Organic Fertilizers on Vegetative Growth

Fajinmi and Odebode (2007) enhanced, pepper cultivated in pot and field recorded significantly at ($p<0.01$) in the leaves number and high of plant, using poultry manure (10 and 20 t ha^{-1}) this research also showed with increase application rate of poultry manure reduce leaves number and high of plant in both pot and field.

According to Shahein et al. (2015) under plastic house bell pepper with application compost manure gave the highest value of plant height but poultry manure came in the second order; while compost and poultry manure were recorded highest value of leaves number.

Ghoname and Shafeek (2005) demonstrated bell pepper in a plastic house, addition of poultry manure in low and high rates; and combined with Bio-N-Fertilizers was recorded highest significant value for plant high, number of leaves and dry weight; when combined high rate poultry manure with Bio-N-Fertilizer comparison without combine or low poultry manure rate.

Abu-Zahra (2012) reported organic fertilizer source influenced significantly under greenhouse, pepper leaves number, shoot dry and fresh weight; while sheep manure recorded highest value than poultry manure and cattle manure, so sheep > poultry > cattle.

According to Jigme et al. (2015) explained broccoli, recorded highest significant deferent for compost & chicken manure tea (200 ml m^2) comparison to compost & chicken manure tea (100 ml m^2) and compost for leaves number, plant height, plant weight and diameter of stem.

Adesina et al. (2014) obtained from the study shows that plant height and number of leaves was significantly affected by different levels of poultry manure; maximum; plant height 21.36 cm and leaves number 86 was recorded with 3.0 t ha^{-1} 4 weeks after transplanting of pepper.

Arancon et al. (2005) application rates 10 t ha^{-1} cattle manure vermicompost affected significantly on large shoot dry weight of pepper at $p<0.05$.

According to Appireddy et al. (2008) showed clearly application with organic manure caused to reduce non-significantly of bell pepper plant high during (51.7 and 54.8) 2005 and 2006.

According to Ikeh et al. (2012) effect of poultry manure 22 t ha^{-1} from 2 weeks after transplanting until 8 weeks on number of pepper leaves, plant high and branches number recorded significantly highest value; so produced (1-6 and 2-9%), (0.4-53 and 0.2-60%) and (4-55 and 5-26%) in both (2007 and 2008) respectively than other treatments; whereas increased with increase poultry manure application.

Ewulo et al. (2008) showed clearly application of poultry manure up to 50 t ha^{-1} of tomato was effected significantly plant height and number of branches increased with level manure.

Mahmoud et al. (2009) indicated using 100% animal compost recorded lower shoot fresh and dry weight than 100% plant compost at prob<0.01 of cucumber during two successive summer seasons 2007 and 2008.

Mehdizadeh et al. (2013) showed deferent type of organic manure effect significantly on both fresh and dry weights of tomatoes shoots and roots by 28.1%, 30.3% compared to control respectively.

Alabi (2006) reported pepper plant height and branches number for two years (2002 and 2003) were increased significantly higher than control when addition 400 and 500 kg ha^{-1} poultry manure.

According to Awodun et al. (2007) indicated that application 2.5, 5, 7.5 and 10 t ha^{-1} goat manure on pepper cultivation increased significantly in (2003 and 2004) at p<0.05 leaves number, branches number, plant height and stem diameter with increase manure application.

Aliyu (2000) showed poultry manure + farmyard manure at application (5+10) and (10+5) t ha-1 on sweet pepper recorded higher plant height and number of branches in the both years (1995 and 1996).

2.6. Effect of Organic Fertilizers on Growth and Yield of Fruit

According to Aliyu (2012) indicated that poultry manure + farmyard in both (1995 and 1996) at application 5 t ha^{-1} supplemented with 50

Fajinmi and Odebode (2007) enhanced pepper cultivated in pot and field recorded significantly at ($p<0.01$) in the number and yield of fruit, using poultry manure (10 and 20 t ha^{-1}) this research also showed with increase application rate of poultry manure reduce number and yield in pot but increase in the field.

Shahein et al. (2015) under plastic house indicated that manure application rates of poultry and compost reduced highest number and weight on bell pepper.

According to Yanar et al. (2011) poultry and cattle manure was recorded highest yield, with application rates 2 t ha^{-1} and 70 t ha^{-1} respectively on tomato; as compared to other organic manures and control, while number of fruit per plant in application rate 2 t ha^{-1} poultry manure was taken a highest value.

Zayed (2013) showed that addition of organic fertilizer significantly increased number of fruit and yield of pepper.

Abu-Zahra (2012) explanted bell pepper under greenhouse; that sheep manure recorded highest pepper fruit number and early 50% blooming date than poultry and cattle manure; while recorded non-significantly fruit weight. According to

Ann (2012) use 0.5 kg compost manure with 3 L ha^{-1} seaweed recorded 3.98 t ha^{-1} yield of pepper.

Hallmann and Rembialkowska (2012) explained for addition 25 t ha^{-1} compost and 20 t ha^{-1} caw manure to bell pepper was recorded significantly increase to dry matter comparison to conventional fertilizers.

According to Ghoname and Shafeek (2005) demonstrated bell pepper in a plastic house, addition of poultry manure in low and high rates; and combined with Bio-N-Fertilizers was recorded highest significant value for fruit number and fresh weight; while non-significant for diameter and length, when combined high rate of poultry manure with Bio-N-Fertilizer comparison without combine or low poultry manure rate.

According to Jigme et al. (2015) explained broccoli, compost & chicken manure tea 200 ml m^2 recorded highest significant for yield was 11 t ha^{-1} comparisons with the compost & chicken manure tea (100 ml m^2) was (10.63 t ha^{-1}) and compost was 9.59 t ha^{-1}.

Adesina et al. (2014) showed that poultry manure with three application 2, 2.5 and 3 t ha^{-1} were statistically higher than the control; Pepper plant that received 3.0 t ha^{-1} poultry manure recorded the highest yield 265 fruits, followed by 2.5 t ha^{-1} application rate 250.33 fruits and the lowest yield observed in control treatment, so the yield increase with an increase in poultry manure rates.

Arancon et al. (2005) pepper treated with paper waste and caw manure vermicomposts at 10 or 20 t ha^{-1} yielded significantly and food waste vermicomposts yielded in the second value.

According to Appireddy et al. (2008) showed clearly application with organic manure on bell pepper caused to reduce non-significantly length fruit (6.8 cm) during 2005 and 2006.

According to Ikeh et al. (2012) reported that poultry manure at application (10 and 8 t ha^{-1}) recorded significant highest number of fruits $plant^{-1}$ and yield of pepper in both (2007 and 2008) respectively; while length of fruit and 50% flowering date were non-significant between treatments in both years; whereas decreased with increase poultry manure application up to 10 t ha^{-1}.

According to Ghorbani et al. (2008) showed clearly sheep manure recorded highest significant yield than cattle and poultry manure of tomato in both (2005 and 2006) at $p<0.05$.

Ewulo et al. (2008) showed clearly application of poultry manure 25 t ha^{-1} was effect highest significantly on number of fruit and yield; while at application 50 t ha^{-1} was became decrease.

Mahmoud et al. (2009) indicated using 100% animal compost recorded lower fresh and dry fruit weight than 100% plant compost at prob<0.01 of cucumber during two successive summer seasons 2007 and 2008.

According to Chellem and Lazarovits (2002) using dried poultry manure recorded non-significantly total yield of cantaloupe.

Mehdizadeh et al. (2013) recorded that effect of deferent manures with application 20 t ha^{-1} decrease significantly tomato yield as follows: Municipal waste compost > Poultry manure > Cow manure > Sheep manure; control recorded lowest value; while caw and sheep manure similar in fruit number; low than poultry manure and higher than control; compost increased the yield by 94.1% while sheep manure increased by 41.1% compared to control at $p<0.05$.

Alabi (2006) reported pepper yield for two years (2002 and 2003) was increased significantly higher than control when addition 500kg ha^{-1} poultry manure 325.2 and 328.6kg ha^{-1} respectively; fruit number, fruit diameter and length increase significantly with increased poultry manure application while days to 50% flowering and days to maturity were reduced.

According to Awodun et al. (2007) indicated that application 2.5, 5, 7.5 and 10t ha^{-1} goat manure on pepper cultivation increased significantly in both (2003 and 2004) at $p<0.05$ fruit number and weight per plant with increase manure application.

According to Ikeh et al. (2013) showed that application 20t ha^{-1} Poultry and goat manure and mixture of them in both (2009 and 2010).

Aliyu (2000) showed poultry manure + farmyard manure at application (5+10) and (10+10) recorded higher fruit number and yield of pepper in both years (1995 and 1996).

2.7. Effect of Organic Fertilizers on Leaf Macronutrient

Ewulo et al. (2008) showed clearly application of poultry manure up to 50 t ha^{-1} was effected significantly on leaf macronutrient N, P and K concentrations at flowering stage of tomato increased with level manure.

Casado-Vela et al (2007) showed sewage sludge compost at application 9 kg m^{-2} from both field and greenhouse caused to increase phosphorus and potassium in the leaves of sweet pepper

2.8. Effect of Organic Fertilizers on Physical and Chemical Properties in Soil

Suge et al. (2011) indicated adding organic fertilizers improve soil physical and chemical properties by addition of sufficient organic matter in the soil, increase nutrient absorption and water holding capacity and then higher yield of eggplant.

According to Adesina et al.(2014) increased in plant height of pepper with poultry manure was mainly affect to low organic matter and N, P and K content.

Arancon et al. (2005) cattle manure vermicompost on pepper affected significantly on amount of nitrate in soil at $p<0.05$; most of the soils treated with vermicompost or composts had significantly more to nitrogen and phosphorus sources.

According to Appireddy et al. (2008) application with organic manure on bell pepper increased significantly of organic matter and pH, while N, P and K amount recorded lower with application of organic matter.

Ewulo et al. (2008) reported application of poultry manure up to 50 t ha^{-1} of tomato increased soil organic matter, N and P; and increased with levels of manure.

Mahmoud et al. (2009) indicated using 100% animal compost recorded higher PH and EC than 100% plant compost at $prob<0.01$ of cucumber during two successive summer seasons 2007 and 2008.

According to Chellem and Lazarovits (2002) observed increase soil PH and ammonia concentration with increase organic application on pepper and tomato.

Stadler (2011) reported at the end of pepper harvest; the amount of nitrogen in the soil increase and should be applied.

According to Awodun et al. (2007) indicated that application 2.5, 5, 7.5 and 10t ha^{-1} goat manure on pepper cultivation increased significantly at $p<0.05$ in (2003 and 2004) soil organic matter, N, P and K with increase manure application; these increase of cations in soil cause to increase soil pH.

3. MATERIALS AND METHODS

3.1. Experimental Site

The experiment was applied from April 23th to July 23th 2016 in a greenhouse 50 m length, 9 m width and 3.5 m high, in a directorate of agricultural research in Iraq – Sulaymaniyah – Bazian. Located between 30˚ 36ˉ 30˭ horizontal and 45˚ 07ˉ 55˭ vertical, with an altitude 847-837 m. Climate of this region is sub-humid. Water resource was from spring. Collected weathering data during the experiment in the greenhouse, the average minimum temperature was 25 °C and the average maximum temperature was 50 °C. Soil was taken in three sites of the field in 15 cm depth and it has not grown in the past five years. Some chemical and physical properties of soil and three manures used in the study are outlined in Table 3.1.; texture of this region is silty clay loam.

Table 3.1. Some chemical and physical properties of soil and three manures were used in the study.

Properties	Symbol	Soil	Poultry	Cattle	Compost
Chemical analyses					
pH	-	7.79	6.90	7.68	7.2
EC	ms cm^{-1}	0.2	12.25	3.95	2
Organic carbon	%	3	40.69	4.02	46.67
N	%	0.16	5.44	3.2	2.2
P	%	16.2*	2.1	0.02	7
K	%	11.6*	2.7	0.15	67
$CaCO_3$	%	25.5	-	-	-
Physical analyses					
Sand	%	9.29	-	-	-
Clay	%	31.66	-	-	-
Silt	%	54.05	-	-	-
Texture	-	Silty clay loam	-	-	-

*: (ppm) of soil phosphor and potassium concentration

3.2. Experimental Design

The experiment was arranged as a randomized design with treatments replicated three times to estimate the effect of organic fertilizers on growth and yield of *Capsicum annuum* var. *annuum* (Grossum Group) (Flavio F1) green sweet bell pepper (Nunhems Netherlands BV) in spring 2016. The treatments were handled as a 3x3 factorial, with no fertilizers and two doses of organic fertilizers. The control plants received no fertilizers applications consists of three treatments of organic fertilizers (poultry, cattle and compost) manure with three doses (0, 30 and 60 ton $hector^{-1}$) Table 3.2. changed to (0, 168 and 336 g 14 kg^{-1} soil) (Dürdan et al. 2011). Seeds of pepper were sown in the seedling trays, which were filled with peat moss; after two weeks pepper seeds (Flavio F1) were germinated, in April 23th bell pepper seedlings were transplanted into plastic pots; and irrigated manually immediately after transplanting with four 1 cm diameter drainage holes drilled on the bottom. Each pot was 23.5 cm tall and 25.5 cm diameter; with putting some small part of Styrofoam in the bottom of pot, one plant pot^{-1} so there were 27 plants. 4 mm sieving soil was used. The poultry and compost manure were from local factory (Shamal and Al-Fayafi) respectively and the cattle manure was from a locally farm, these manures existed in Iraq - Sulaymaniah. Soil and manure was mixed together. No prohibited pesticides were applied in the greenhouse during the course of the experiment.

Table 3.2. Symbols of treatments and doses were used in this study

Symbols	Manures and application rates
P.M. 0	Zero
P.M. 1	30 ton hector^{-1} Poultry manure
P.M. 2	60 ton hactor^{-1} Poultry manure
Ca.M 0	Zero
Ca.M. 1	30 ton hector^{-1} Cattle manure
Ca.M. 2	60 ton hector^{-1} Cattle manure
Co.M. 0	Zero
Co.M. 1	30 ton hectore^{-1} Compost manure
Co.M. 2	60 ton hectore^{-1} Compost manure

3.3. Plant Measurements

Plant samples were taken in two stages, flowering stage and harvest stage for all plants, measurements and analyses have been conducted as following.

3.3.1. Vegetative Growth Characteristics

1- Plant high cm plant^{-1} and number of leaves were taken week after transplanting until ten weeks.

2- Flowering
The number of days from transplanting until 50% blooming Figure 3.1. was recorded, Ca.M.1 and P.M.1 (after 35 days), Co.M.1and Ca.M.2 (after 36 days) Co.M.2 and Control (after 37 days) P.M.2 (after 44 days) of transplanting.

3- Leaf analysis

At the starting of flowering, leaf samples were collected 3-5 leaves per plant and oven dried at 65C^o for 48 hours; to estimate and study the effect of organic fertilizers on leaf N, P and K concentrations. These analyses were determined in a central laboratory in Bingöl University.

a) Nitrogen (Kacar 1972)

0.025 g leaves put it in an aluminum cup, and then directly reading.

*(Digestion): 0.25 g leaves add 10 ml HNO_3 digested for 3 hours, after cooled put it in a plastic tube and diluted with 25 ml D.W.

b) Phosphorus (Kacar 1972)

Material preparation:

1. Sodium bicarbonate (0.5 N $NaHCO_3$)

24 g $NaHCO_3$ dissolve in 1 L beaker flask supplemented with D.W., regulate PH of this solution on 8.5 by add 0.5N hydrochloric acid HCl or 50% sodium hydroxide NaOH.

2. Morphy-Rally solution

a) 12 g ammonium hepta molybdate $[(NH_4)_6Mo_7O_{24}.4H_2O]$ dissolved in 250 ml beaker flask supplemented with D.W.

b) 0.290 g of potassium antimony oxide $[K(SbO).C_4H_4O_{6}.{}_{1/2}H_2O]$ in beaker flask supplemented with D.W.

c) The two solutions mixed together in 2 L beaker flask, and then add 138.9 ml of concentrated H_2SO_4 (1.84 density) slowly-slowly with stirring. Leaved to cool and then supplemented with D.W. to 2 L and store it in a dark bottle.

3. L-Ascorbic acid solution

Dissolve 0.53 g L-ascorbic acid in 100 ml of Morphy-Rally solution, and then store in a dark bottle. This solution must prepare daily because it is expire after 24 hours.

Procedure

Diluted 40 ml of $NaHCO_3$ in 100 ml beaker flask supplemented with D.W. Add 5 ml dilute $NaHCO_3$ and 5 ml digest solution in to a 25 ml volumetric flask supplemented with D.W., and then read at (RPM 160) for 30 min.

Calculation

P ppm = (ppm in blue extract X 100 X 50 X 5) / 10000 = P%

100: 0.25 g dissolved in 25 ml

50: 0.5 ml diluted to 25 ml

5: 25 ml diluted to 5 ml

c) Potassium (Kacar 1972)

From 25 ml (Digestion) was taken 0.5 ml diluted to 10 ml, and then read.

Calculation:

K ppm = (K ppm (Digestion) X 100 X 20) /10000 = K%

100: 0.25 g dissolved in 25 ml

20: 0.5 ml diluted to 10 ml

4- Shoot fresh weight measured (g $plant^{-1}$) included stem and leaves after drying on 65 °C for 48 hours was measured shoot dry weight.

5- Root fresh weight was measured (g $plant^{-1}$) after drying was measured root dry weight on 65 °C for 48 hours.

3.3.2. Soil and Cattle Manure Analysis

Some physical and chemical analyses conducted for soil any treatments. These analyses were determined in laboratory of agricultural research directorate in Iraq-Sulaymaniyah.

1- Physical Analysis:

Soil texture (Pipet method)

a) 12 g soil air dry put it in 400 ml beaker then wetted with D.W.

b) Add 10 ml hydrogen peroxide (H_2O_2) then covered to 24 hours.

c) Placed the beaker on water bath on 70 °C to a half hour then cooled and add 10 ml H_2O_2.

d) Continue on this process for 6 times.

e) In the 9^{th} day put the beaker in a water bath on 70 °C for 2 hours to evaporate all H_2O_2 then leaved to cool down and then filtration.

f) Mobility the soil to the oven in the some beaker on 105 °C to 24 hours.

g) Weighted the soil accurately so that is oven dry soil.

h) Add 20 ml calgon 5% and leave to 24 hours.

i) Mobility beaker all contains in to the mixer for 15 min.

j) Passed in (sieve 0.050 mm) for separate all sand parts in to a beaker known weight by drop of water, and then leave until dry then weight.

k) All remainder put in 1 L slender supplemented with D.W., mixes by Blonger (20-16) times then measured temperature of the solution with a table of temperature, Extracted required time to deposition silt parts after limit time, take a sample from the stuck with pipet in a depth 10 cm, and then put in the beaker known weight then dry in the oven and weight for second time.

2- Chemical Analysis for Soil and Cattle Manure

1- pH (Rine et al. 2003)

Soil (1:1)

40 g soil 2 mm air dry dissolved in 40 ml D.W., after 24 hours measured with pH meter.

Cattle manure (1:3)

10 g manure dissolved in 30 ml D.W., after 24 hours measured with pH meter.

2- EC (dm m^{-1}) (Rine et al. 2003)

Prepared same pH extract; and then measured with EC meter multiplied by a factor of temperature table.

3- Organic Matter (Rine et al. 2003)

a) Phosphoric acid H_3PO_4 85%

b) Sulfuric acid H_2SO_4 85%

c) Dichromate solution $K_2Cr_2O_7$ 1 N

Dissolved 49.04 g in 1 L D.W.

d) Ferrous ammonium sulfate solution $[(NH_4)_2SO_4.FeSO_4.6H_2O]$ 0.5 M

Dissolve 196 g in 800 ml D.W.; add 5 ml H_2SO_4, then complete to 1 L

e) Organic matter indicator

0.695 g Ferrous sulfate $FeSO_4.7H_2O$ with 1.85 g o-Phenanthroline monohydrate ($C_{12}H_8N_2.H_2O$) 1 N 100 ml D.W.

Procedure

a) 0.5 g soil 2 mm sieving in 500 ml conical flask.

b) Add 10 ml $K_2Cr_2O_7$

c) Add 20 ml H_2SO_4 mixture well to 5 min. leaved to a half hour; and then dilute the mix to 200 ml D.W.

d) Add 10 ml H_3PO_4 with 5 drop organic matter indicator.

e) Titrate with ferrous ammonium sulfate until change the color from orang to maroon, and then inter volume of titration (T).

f) Prepare blank in same way only without soil.

Calculation

$$C\% = \frac{(B-T) * N}{\text{Wt soil}} \times \frac{12}{4000} \times \frac{1}{0.77} \times 100$$

O.M% = C% X (1/0.58)

B: Blank T: Titration

4- **Calcium Carbonate ($CaCO_3$) (Rine et al. 2003)**

Material preparation

a) HCl 1 N

Diluted 82.8 ml of (HCl 1.19 37%)

b)NaOH 1N

Dissolve 40 g NaOH in 1 L D.W.

c)Desiccator phenolphthalein [$C_6H_4COOC(C_6H_4$-4-0-H$)_2$]

Dissolve 0.5 g in 100 ml ethanol.

d) Desiccator methyl orang [4-$NaOSO_2C_6H_4N$:N_8H_4-4-N$(CH_3)_2$]

Dissolve 0.1 g in 100 ml D.W.

e) Ethanol 95% (C_2H_5OH).

f) Sodium carbonates 1 N Na_2CO_3.

Dissolve 53 g in 1 L D.W.

Procedure

1- 1gm soil (0.15 mm) sieve dissolve in 250 ml D.W.

2- 10 ml HCl 1 N.

3- Shake it and put on a hot plate 50-60 °C.

4- Add 50-100 ml D.W. and 2-3 drop Phenolphthalein.

5- Titrate with NaOH with shake until change to pink.

Calculation

$\%CaCO_3 = [(10 \times N_{HCl}) - (R \times N_{NaOH})] \times 0.05 \times (100/Wt)$

R = Volume (ml) of NaOH using in the titration.

Wt = Weight (g) of air dry soil.

5- **Nitrogen (Kjeldahl digestion) (Rine et al. 2003)**

Material preparation

a) Kjeldahl grains (1 g $CuSO_4.5H_2O$ and 1 g Na_2SO_4)

b) H_2SO_4 98%

c) Boric acid solution

Dissolve 20 g in 1 L H_2O, prepared weekly.

d) Mixture indicator

Dissolve 0.1 g methyl red and 0.2 g procrisol green in 250 ml ethanol 95%.

e) NaOH solution

Dissolve 100 g in 200 ml D.W.

f) HCl 0.01 M

Procedure

1- Digestion

a) 2 g of soil dry weight in kjeldhal flask.

b) Add 2.5 g Na_2SO_4 and 0.5 g $CuSO_4.5H_2O$.

c) Add 4 ml H_2O shacked annually and add 6 ml H_2SO_4.

d) Heat carefully on 60 °C to a half hour until the liberation of gases and vapor H_2SO_4 and then raise temperature to 380 °C.

e) Continue on heat 380 °C to 1 hour until change solution color to white.

f) Cool the flask by adding 20 ml D.W. and leaved to 20 min. until precipitate the sand.

g) Pour the solution in to volumetric 100 ml and be sure to transport all solution, then supplement to 100 ml.

2- Distillation

a) Put 10 ml of boric acid in a conical flask and add 5 drop mixture indicator until change to pink.

b) Add 50 ml of the sample was diluted in to a distillation flask.

c) Add 10 ml NaOH and put in a distillation room and then closed well.

d) After change color mixture solution of boric acid from pink to green then the solution ready to titration.

3- Titration

a) Titrate with HCl 0.01 M until change from green to pink

b) Reaped the titration with blank (contain all materials in the digestion proses only soil sample)

Calculation

V (Volume user acid) = V (Volume sample user acid) – V (Volume blank user acid)

N% = V X M X (14/1000) X (100/50) X (100/Wt of soil)

V: Volume user acid	100: Supplement to 100 ml
M: Molarity user acid	50: Extract volume
14: eq.wt. N	100: In all 100 g soil (%)
1000: Conversion mg to g.	

6- **Available Phosphorus (Rine et al. 2003)**

a) Preparation of sodium bicarbonate solution $NaHCO_3$ 0.5 M Weight 42 g dissolved in 1L D.W. and adjusted pH on 8 with diluted NaOH.

Extraction:

- 5gm soil (sieve 2 mm).
- Add 100 ml ($NaHCO_3$ 0.5 M) and shake to 30 min and then filtered.

b) H_2SO_4 1.5 M prepare from 80 ml H_2SO_4 98% dissolve in 1 L D.W.

c) Ammonium molybdate solution prepare from 12 g ammonium molybdate $(NH_4)_6Mo_7O_{24}.4H_2O$ add 0.3 g of Antimony potassium tartarate $KSbOC_4H_4O_6$ dissolved in 600 ml D.W. add slowly 148 ml H_2SO_4 98% supplemented mix with 125 ml of this solution with 875 ml D.W. put it in a cold place.

d)Ascorbic acid $C_6H_8O_6$

Dissolve 1.5 g in D.W. and supplemented to 100 ml, prepared daily.

e) Standard phosphate

- Dry amount of potassium phosphate two hydrogen KH_2PO_4 in the oven on 105 °C to 1 hour then weight 4.387 g and dissolve in 1 L D.W. then we get solution 1000 ppm for phosphorus.
- From this solution prepare 100 ppm, 10 ppm then 1 ppm, of 1 ppm prepare (0.05, 0.1, 0.15, 0.20, 0.25, 0.30, 0.35 and 0.40 ppm P).
- Diluted the solute 1000 ppm as this law (rule) $C_1V_1=C_2V_2$

To prepare 100 ppm of 1000 ppm in volumetric 100 ml.$1000 \times V_1 = 100 \times 100$

$V_1 = 10$ ml

- Add to any volumetric flask 5 ml of sodium bicarbonate, 1 ml of H_2SO_4 1.5 M, 5 ml ammonium molybdate and 5 ml ascorbic acid.
- Heat it until change to blue color after that cools and supplemented with H_2O and leave it to 20 min and then read with spectrophotometer 880 mm.

P ppm = P ppm in blue extract X 20 X 10

20: 5 ml diluted to 100 ml D.W.   10: 5 g devolved in 50 ml D.W.

7- **Potassium (Rine et al. 2003)**

Solutions:

a) Ammonium acetate solution 1 N NH_4OAC

1- Diluted 57 ml CH_3COOH in 800 ml D.W. and add 68 ml BH_4OH shake and cool it.

2- Adjusted pH on 7 with adds either ascorbic acid or ammonium hydroxide, and then supplemented to 1 L D.W.

b) Standard mother solution

1- Dry near 3 g of KCl in oven on 120 °C to 1-2 hour, cool and store in bottle.

2- Dissolve 1.907 g KCl in H_2O and supplemented to 1 L D.W. This solute contains 1000 ppm of potassium (mother solution).

3- Prepare 2, 4, 6, 8, 10, 15 and 20 ml of mother solution in 100 ml volumetric flask and supplemented with D.W. or ammonium acetate 1 N, then solutions contain 20, 40, 60, 100, 150 and 200 ppm of potassium.

Procedure

1- Dissolved 5 g soil (<5 mm) in 50 ml D.W.; centrifuges and add 33 ml ammonium acetate shake until 5 min.

2- Filtered the solution in a volumetric 100 ml.

3- Diluted the extract ammonium acetate to ammonium acetate 1 N.

4- Read the standard solutions and draw the curve.

5- Read soil solutions with flame photometer on 767 nm.

6- Calculate potassium concentration from the curve.

Calculation

Extractable K ppm = K ppm in the curve X (A/Wt)

A: Volume of total solution   Wt: Weight of air dry soil

3.3.3. Harvest

Bell pepper fruit were harvested by hand for three times, and was weighed the yield for any plant measured g $plant^{-1}$, dried in oven at 65 °C to 48 hours to measured dry matter in the fruit (Figure 3.2).

3.3.4. Statistical Analysis

Statistical analyses were conducted using JMP 7. The Least Significant Difference (LSD) test (prob<0.05, prob<0.01, prob<0.001) from ANOVA table was done to find the significant differences between treatments at level (0.05).

4. RESULT AND DISCUSSION

4.1. Effect of Organic Fertilizers, Application Rates and their Interaction on Vegetative Growth

Plant height cm plant^{-1} and number of leaves plant^{-1} were recorded weekly, week after transplanting until ten weeks and at harvest for any treatment after third pick recorded some plant properties.

The results in Table 4.1. show that the highest plant high was recorded through control and P.M.1 21.28 and 24.4 cm plant^{-1} respectively at prob<0.001; while application 60 t ha^{-1} P.M.2 16.90 and 13.70 cm plant^{-1} recorded lowest plant high. Manures recorded non-significant plant high, also show cattle manure, application 30 t ha^{-1} and P.M.1 recorded highest significant leaves number 44.88, 45.98 and 57.20 no. plant^{-1} at prob<0.05, prob<0.01 and prob<0.001; while compost, application 60 t ha^{-1} and P.M.2 recorded lowest 39.56, 37.23 and 26.80 no. plant^{-1}.

Table 4.2. show poultry manure recorded highest shoot fresh weight 103.67 g plant^{-1} at prob<0.001, cattle manure recorded lowest 46.54 g plant^{-1}; while application rates and their interaction were non-significant. Poultry manure, application 30 t ha^{-1} and them interaction recorded highest significant shoot dry weight 23.49, 19.55 and 38.38 g plant^{-1} respectively at prob<0.001; while compost manure, control recorded lowest 10.19, 8.13 g plant^{-1} respectively.

Table 4.3. show application 30 t ha^{-1} and P.M.1 recorded highest significant root fresh weight at prob<0.01 and prob<0.001 28.38 and 37.27 g plant^{-1} respectively; while application 60 t ha^{-1} and P.M.2 recorded lowest root fresh 22.28 and 16.80 g plant^{-1} at prob<0.01 and 0.001 respectively. Poultry manure recorded highest root dry weight 6.15 g plant^{-1} at prob<0.01; while compost manure recorded lowest 4.13

g.plant^{-1}. Manures and application rates recorded non-significant on root fresh and dry weight respectively.

Table 4.4. show poultry manure and P.M.1 recorded highest significant stem diameter 9.2 and 10.67 mm plant^{-1} at prob<0.01 and prob<0.05 respectively; while cattle manure and Ca.M.2 recorded lowest 7.5 and 6.5 mm plant^{-1} respectively, also show manures, application rates and there interaction affected non-significantly on main and sub-branches number only application 30 t ha^{-1} was effect significantly on increase sub-branches number 15.6 plant^{-1} at prob<0.05 and lowest recorded through control 10.9 plant^{-1}.

These results indicated that poultry manure and cattle manure were affected significantly on plant high and leaves number at application 30 t ha^{-1}. Decrease shoot dry and root fresh weight with increased manure application rates; while with increase application manures. Manure application rates effect non-significantly on shoot fresh, root dry weight, stem diameter and main branches (Aliyu 2000; Fajinmi and Odebode 2007; Ewulo et al. 2008; Abu-Zahra 2012; Ikeh et al. 2012; Mehdizadeh et al. 2013 and Shahein et al. 2015).

Table 4.1. Effect of organic fertilizers, application rates and their interaction on plant high cm plant^{-1} and leaves number plant^{-1}

	Manures application rates (t ha^{-1})							
Manures	**Plant high**				**Leaves number**			
	Zero	30	60	Mean	Zero	30	60	Mean
Poultry	22.38 b	24.4 a	13.70 g	20.16 a	39.63 bc	57.20 a	26.80 d	41.21 ab
Cattle	20.17 cd	19.46 de	18.57 d-f	19.40 ab	45.23 b	44.60 b	44.80 b	44.88 a
Compost	21.30 bc	17.61 f	18.43 ef	19.12 b	42.45 bc	36.13 c	40.10 bc	39.56 b
Mean	21.28 a	20.49 a	16.90 b		42.44 a	45.98 a	37.23 b	
L.S.D 0.05	Manures N.S	Application rates 0.97		Interaction 1.68	Manures 3.89	Application rates 3.89		Interaction 6.72
F test	-	***		***	*	***		***

*: Means value significant at prob≤0.05 **: Means value significant at prob≤0.01 ***: Means value significant at prob≤0.001 N.S: Means value non-significant Means followed by same letter (s) for manures, application rates and interaction are not significantly deferent at LSD 0.05 according to student's t. Fertilizer control and doses control are same.

Table 4.2. Effect of organic fertilizers, application rates and their interaction on shoot fresh and dry weight gm plant^{-1}

Manures application rates (t ha^{-1})								
Manures	Shoot fresh				Shoot dry			
	Zero	30	60	Mean	Zero	30	60	Mean
Poultry	67.22	138.45	105.34	103.67 a	14.19 bc	38.38 a	17.89 b	23.49 a
Cattle	37.52	54.95	47.14	46.54 b	8.13 c	11.61 bc	11.06 c	10.27 b
Compost	45.20	41.10	57.25	47.85 b	10.06 c	8.64 c	11.86 bc	10.19 b
Mean	49.98 b	78.17 a	69.91 ab		10.80 b	19.55 a	13.60 b	
L.S.D 0.05	Manures 23.3	Application N.S	Interaction N.S		Manures 3.82	Application 3.82	Interaction 6.62	
F test	***	-	-		***	***	***	

*: Means value significant at prob≤0.05 **: Means value significant at prob≤0.01 ***: Means value significant at prob≤0.001 N.S: Means value non-significant Means followed by same letter (s) for manures, application rates and interaction are not significantly deferent at LSD 0.05 according to student's t. Fertilizer control and doses control are same.

Table 4.3. Effect of organic fertilizers, application rates and their interaction on root fresh and dry weight gm plant^{-1}

Manures application rates (t ha^{-1})								
Manures	Root fresh				Root dry			
	Zero	30	60	Mean	Zero	30	60	Mean
Poultry	26.23 bc	37.27 a	16.80 d	26.76	7.04	7.41	4.0	6.15 a
Cattle	23.75 bc	26.71 bc	21.89 cd	24.63	3.37	5.27	3.85	4.16 b
Compost	24.57 bc	21.16 cd	28.17 b	24.12	4.48	3.68	4.24	4.13 b
Mean	24.85 ab	28.38 a	22.28 b		4.96	5.45	4.03	
L.S.D 0.05	Manures N.S	Application 3.59	Interaction 6.20		Manures 1.34	Application N.S	Interaction N.S	
F test	-	**	***		**	-	-	

*: Means value significant at prob≤0.05 **: Means value significant at prob≤0.01 ***: Means value significant at prob≤0.001 N.S: Means value non-significant Means followed by same letter (s) for manures, application rates and interaction are not significantly deferent at LSD 0.05 according to student's t. Fertilizer control and doses control are same.

Table 4.4. Effect of organic fertilizers, application rates and their interaction on stem diameter mm plant^{-1}; main branch and sub branch plant^{-1}

Manure application rates (t ha^{-1})												
Manures	Stem diameter				Main branch				Sub branch			
	Zero	30	60	Mean	Zero	30	60	Mean	Zero	30	60	Mean
Poultry	8 bc	10.67 a*	9 ab	9.2 a	2.7 a	3.2 a	3.3 a	3.1 a	11.3 a	19.3 a	16.0 a	15.6 a
Cattle	8 bc	8 bc	6.5 c	7.5 b	3 a	2.7 a	4 a	3.2 a	10.3 a	11.7 a	18.3 a	13.4 a
Compost	8. bc	7.5 bc	9 ab	8.17 b	3 a	3.7 a	2.7 a	3.1 a	11.0 a	15.7 a	11.3 a	12. a
Mean	8 a	8.72 a	8.17 a		2.9 a	3.2 a	3.3 a		10.9 b	15.6 a	15.2 a	
L.S.D 0.05	Manures 0.99	Application N.S		Interaction 1.72	Manures N.S	Application N.S		Interaction N.S	Manures N.S	Application 3.97		Interaction N.S
F test	**	-		*	-	-		-	-	*		-

*: Means value significant at prob≤0.05 **: Means value significant at prob≤0.01 ***: Means value significant at prob≤0.001 N.S: Means value non-significant Means followed by same letter (s) for manures, application rates and interaction are not significantly deferent at LSD 0.05 according to student's t. Fertilizer control and doses control are same.

4.2. Effect of Organic Fertilizers, Application Rates and their Interaction on Growth and Yield of Fruit

Results in Table 4.5. Figure 4.1.during the experiment taken three picks of pepper. After (64 and 71) days of transplanting P.M.1, Ca.M.1, Ca.M.2, Co.M.1, Co.M.2, P.M.2 and control were picked. Cattle manure, application 30 t ha^{-1} and them interaction recorded highest significant fruit weight 88.66, 94.89 and 122.11 g $plant^{-1}$ respectively at prob<0.01; while poultry manure, control and P.M.2 recorded lowest weight 62.18, 68.30 and 35.50 g $plant^{-1}$ respectively Figure 4.2.

After 71 days P.M1, Ca.M.2 and Co.M.1 were taken the second pick; While Co.M.2 (after 73 days), control and Ca.M.1 (after 75 days) and P.M.2 (after 81 days) were matured. Poultry manure, application 30 t ha^{-1} and their interaction recorded highest significant fruit weight 45.54, 43.28 and 73.63 g $plant^{-1}$ at prob<0.01, 0.05 and 0.001 respectively; while cattle manure, application 60 t ha^{-1} and P.M.2 interaction recorded lowest weight 29.87, 25.23 and 26.48 g $plant^{-1}$ respectively.

After 77 days P.M.1 and Ca.M.2 recorded the third pick; while control, Ca.M.1, Co.M.1 and Co.M.2 after 84 days; while P.M.2 after 91days were picked. Poultry manure, and P.M1 interaction recorded highest significant fruit weight 56.04 and 95.77 g $plant^{-1}$ at prob<0.05 and 0.01 respectively; while compost manure and Co.M.2 recorded lowest weight, and application recorded non-significant.

Table 4.6. at first pick, compost manure, application 30 t ha^{-1} and them interaction recorded highest significant fruit number 2.78, 3.22 and 3.67 no. $plant^{-1}$ respectively at prob<0.01, prob<0.001 and prob<0.01; while poultry manure, control and P.M.1 recorded lowest fruit number 1.77, 1.56 and 1.0 no. $plant^{-1}$. Second pick recorded non-significant deferent. At third pick poultry manure and P.M.1 were recorded highest significant fruit number 1.56 and 2.67 no. $plant^{-1}$ at prob<0.05 and prob<0.01; while compost manure and Co.M.2 recorded lowest fruit number 0.78 and 0.33 no. $plant^{-1}$, however application rates recorded non-significant deferent. These results indicated manures application rates didn’t effect on increase number of fruit.

Table 4.7. after measurements of fruit weight was dried in oven 65°C for 48 hours. At first pick cattle manure, application 30 t ha^{-1} and them interaction was recorded highest significant dry matter 6.11, 6.94 and 8.53 g $plant^{-1}$ at prob<0.05, prob<0.01 and prob<0.05 respectively; while poultry manure, control and P.M.1 recorded lowest dry matter 4.37, 3.95 and 3.32 respectively. At second pick poultry manure, application 30 t ha^{-1} and them interaction recorded highest significant dry matter 3.49, 3.33 and 5.04 g $plant^{-1}$ at prob<0.05, prob<0.01 and prob<0.01 respectively; while cattle manure, application 60 t ha^{-1} and Co.M.2 recorded lowest dry matter respectively. At third pick poultry manure and P.M.1 were recorded highest significant dry matter 5.06 and 9.29 g $plant^{-1}$ at prob<0.01 respectively; while compost manure and Co.M.2 recorded lowest dry matter 1.92 and 0.41 g $plant^{-1}$ respectively, however application rates recorded non-significant deferent.

Table 4.8. at first pick cattle manure 30 t ha^{-1} was recorded highest significant diameter of pepper 53.07 mm $plant^{-1}$ at prob<0.05, while cattle manure 60 t ha^{-1} recorded lowest diameter 43.8 mm $plant^{-1}$. Manures and application rates at first and second pick were recorded non-significant deferent of pepper diameter. At third pick also manures and interaction were affected non-significantly; while control recorded highest significant diameter 48.82 mm $plant^{-1}$ at prob<0.05 and application 60 t ha^{-1} recorded lowest.

Table 4.9. show at first and second picks fruit recorded non-significant for length of pepper. At third pick control recorded highest length 55.05 mm $plant^{-1}$ at prob<0.05; while application 60 t ha^{-1} recorded lowest 31.71 mm $plant^{-1}$. Manures affected non-significantly on length of pepper. Figure 4.3. show manures affected non-significantly on yield t ha^{-1} of pepper for three picks; while Figure 4.4. and 4.5. indicated that application rates and interaction respectively affected significantly on yield at prob<0.001.

These results show weight, number and dry matter of pepper decrease with increased manure application rates; while affected non-significantly on fruit diameter and length

(Aliyu 2000; Ghoname and Shafeek 2005; Fajinmi and Odebode 2007; Ewulo et al. 2008; Appireddy et al. 2008; Ghorbani et al. 2008; Yanar et al. 2011; Abu-Zahra 2012; Ikeh et al. 2012; Mehdizadeh et al. 2013).

Table 4.5. Effect of organic fertilizers, application rates and their interaction on fresh weight of pepper gm plant^{-1}

Manures	Manure application rates (t ha^{-1})											
	First pick				**Second pick**				**Third pick**			
	Zero	30	60	Mean	Zero	30	60	Mean	Zero	30	60	Mean
Poultry	84.40 bc	66.66 b-d	35.50 d	62.18 b	36.52 bc	73.63 a	26.48 c	45.54 a	57.27 b	95.77 a	15.08 cd	56.04 a
Cattle	53.68 cd	122.11 a	90.21 ab	88.66 a	32.07 c	27.62 c	29.93 c	29.87 b	29.91 b-d	18.76 cd	54.68 b	34.45 b
Compost	66.81 b-d	95.89 ab	91.99 ab	84.90 a	52.85 b	28.57 c	19.29 c	33.57 b	43.59 bc	24.56 b-d	5.53 d	24.56 b
Mean	68.30 b	94.89 a	72.56 b		40.48 a	43.28 a	25.23 b		43.59 ab	46.36 a	25.09 b	
LSD 0.05	Manures 20.75	Application 20.75	Interaction 35.95		Manures 10.97	Application 10.79	Interaction 18.71		Manures 19.76	Application N.S	Interaction 34.23	
F test	**	**	**		*	**	***		*	-	**	

*: Means value significant at prob≤0.05 **: Means value significant at prob≤0.01 ***: Means value significant at prob≤0.001 N.S: Means value non-significant Means followed by same letter (s) for manures, application rates and interaction are not significantly deferent at LSD 0.05 according to student's t. Fertilizer control and doses control are same.

Table 4.6. Effect of organic fertilizers, application rates and their interaction on number of pepper No. plant^{-1}

Manures	Manure application rates (t ha^{-1})											
	First pick				**Second pick**				**Third pick**			
	Zero	30	60	Mean	Zero	30	60	Mean	Zero	30	60	Mean
Poultry	1.67	2.67 b	1.0 c	1.77 b	1	1.67	1	1.22	1.33 bc	2.67 a	0.67 cd	1.56 a
Cattle	1.33 c	3.33 ab	3.33 ab	2.67 a	1.33	1.33	1	1.22	1 bc	1 cd	2 ab	1.33 a
Compost	1.67 c	3.67 a	3.0 ab	2.78 a	1	1	1	1	1 cd	1 cd	0.33 d	0.78 b
Mean	1.56 c	3.22 a	2.44 b		1.11	1.33	1		1.11	1.56	1	
LSD 0.05	Manures 0.50	Application 0.50		Interaction 0.88	Manures N.S	Application N.S		Interaction N.S	Manures 18.04	Application N.S		Interaction 31.25
F test	**	***		**	-	-		-	*	-		**

*: Means value significant at prob≤0.05 **: Means value significant at prob≤0.01 ***: Means value significant at prob≤0.001 N.S: Means value non-significant Means followed by same letter (s) for manures, application rates and interaction are not significantly deferent at LSD 0.05 according to student's t. Fertilizer control and doses control are same.

Table 4.7. Effect of organic fertilizers, application rates and their interaction on dry matter of pepper g plant^{-1}

Manure application rates (t ha^{-1})												
Manures	First pick				Second pick				Third pick			
	Zero	30	60	Mean	Zero	30	60	Mean	Zero	30	60	Mean
Poultry	4.43 cd	5.35 b-d	3.32 d	4.37 b	3.44 b	5.04 a	2 c	3.49 a	4.55 b	9.29 a	1.35 cd	5.06 a
Cattle	3.27 d	8.53 a*	6.55 a-c	6.11 a	2.29 bc	2.29 bc	2.63 bc	2.41 b	2.53 b-d	1.42 cd	4.36 bc	2.77 b
Compost	4.16 cd	6.95 ab	6.40 a-c	5.84 a	3.66 ab	2.66 bc	1.55 c	2.63 b	3.54 bc	1.82 b-d	0.41 d	1.92 b
Mean	3.95 c	6.94 a	5.42 b		3.13 a	3.33 a	2.06 b		3.54 ab	4.17 a	2.04 b	
LSD 0.05	Manures 1.39	Application 1.39		Interaction 2.42	Manures 0.80	Application 0.80		Interaction 1.37	Manures 1.74	Application N.S		Interaction 3.02
F test	*	**		*	*	**		**	**	-		**

*: Means value significant at prob≤0.05 **: Means value significant at prob≤0.01 ***: Means value significant at prob≤0.001 N.S: Means value non-significant Means followed by same letter (s) for manures, application rates and interaction are not significantly deferent at LSD 0.05 according to student's t. Fertilizer control and doses control are same.

Table 4.8. Effect of organic fertilizers, application rates and their interaction on diameter of pepper mm plant^{-1}

Manure application rates (t ha^{-1})												
Manures	First pick				Second pick				Third pick			
	Zero	30	60	Mean	Zero	30	60	Mean	Zero	30	60	Mean
Poultry	52.2 ab	44.83 de	51.43 a-c	49.49 a	50.87 a	49.78 a	43.50 a	48.05 a	54 a	50.17 ab	26.87 bc	43.68 a
Cattle	49.4 a-e	53.07 a	43.8 e	48.76 a	44.53 a	44.37 a	45.27 a	44.72 a	43.63 a-c	30.63 a-c	47.10 ab	40.46 a
Compost	50.83 a-d	46.77 b-e	45.57 c-e	47.72 a	47.16 a	48.37 a	27.30 b	40.94 a	48.82 ab	48.67 ab	13.17 c	36.88 a
Mean	50.81a	48.22 ab	46.93 b		47.52 a	47.51 a	38.69 a		48.82 a	43.16 ab	29.04 b	
LSD 0.05	Manures N.S	Application N.S	Interaction 6.03		Manures N.S	Application N.S	Interaction N.S		Manures N.S	Application 14.43	Interaction N.S	
F test	-	-	*		-	-	-		-	*	-	

*: Means value significant at prob≤0.05 **: Means value significant at prob≤0.01 ***: Means value significant at prob≤0.001 N.S: Means value non-significant Means followed by same letter (s) for manures, application rates and interaction are not significantly deferent at LSD 0.05 according to student's t. Fertilizer control and doses control are same.

Table 4.9. Effect of organic fertilizers, application rates and their interaction on length of pepper mm plant^{-1}

	Manure application rates (t ha^{-1})											
Manures	First pick				Second pick				Third pick			
	Zero	30	60	Mean	Zero	30	60	Mean	Zero	30	60	Mean
Poultry	66.37 a	50.43 b	48.47 b	55.09 a	54.80 a	58.35 a	49.17 a	54.11 a	56.70 a	48.07 ab	30.30 ab	45.02 a
Cattle	54.83 ab	57.27 ab	48.80 b	53.63 a	52.70 a	51.45 a	47 ab	50.38 a	53.33 a	34.80 ab	46.67 ab	44.93 a
Compost	59.23 ab	50.10 b	56.67 ab	55.33 a	55.53 a	46.43 ab	29.96 b	43.97 a	55.11 a	45.33 ab	18.17 b	39.54 a
Mean	60.14 a	52.60 b	51.31 b		54.34 a	52.08 ab	42.04 b		55.05 a	42.73 ab	31.71 b	
LSD 0.05	Manures N.S	Application N.S	Interaction N.S		Manures N.S	Application N.S	Interaction N.S		Manures N.S	Application 17.33	Interaction N.S	
F test	-	-	-		-	-	-		-	*	-	

*: Means value significant at prob≤0.05 **: Means value significant at prob≤0.01 ***: Means value significant at prob≤0.001 N.S: Means value non-significant Means followed by same letter (s) for manures, application rates and interaction are not significantly deferent at LSD 0.05 according to student's t. Fertilizer control and doses control are same.

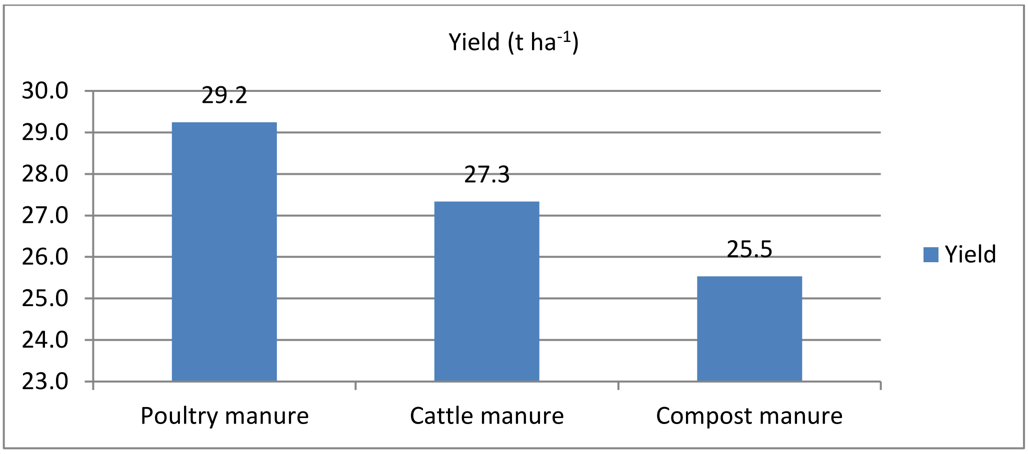

Figure 4.3. Effect of manures fertilizers on yield of pepper t ha^{-1}

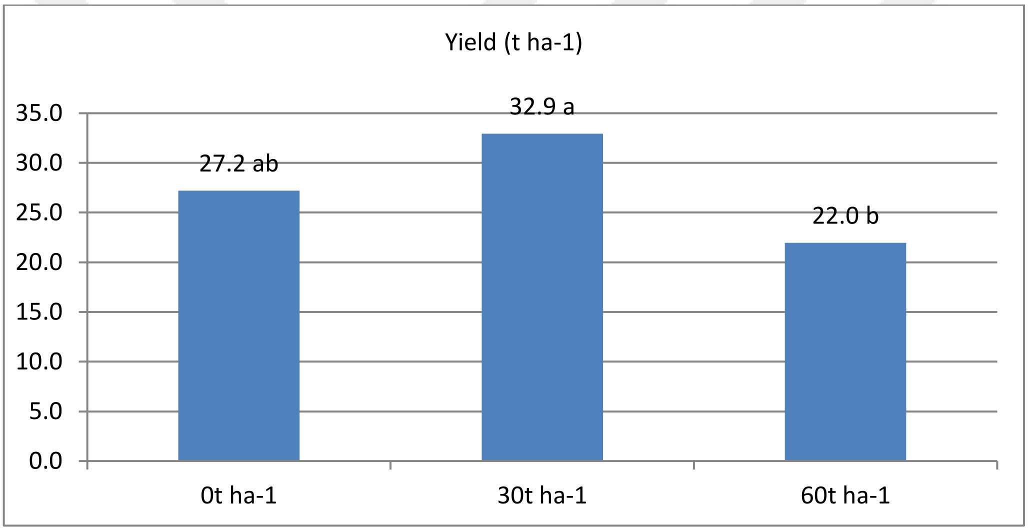

Figure 4.4. Effect of manure application rates on yield of pepper t ha^{-1}

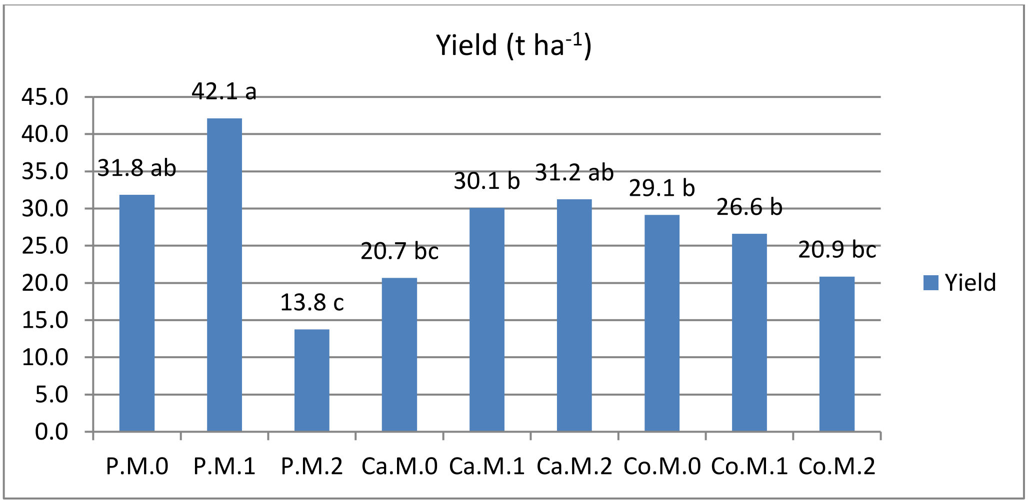

Figure 4.5. Effect of interaction between manures and application rates on yield of pepper t ha^{-1}

4.3. Effect of Organic Fertilizers, Application Rates and their Interaction on N, P and K Concentration in Leaves at Flowering Stage.

Table 4.10. show Poultry manure and application 60 t ha^{-1} effect significantly and recorded highest leaf N concentration 1.94% and 1.73% at prob<0.01 and prob<0.05 respectively; while cattle manure and control recorded lowest 1.08% and 1.10%. Interaction recorded non-significant. Application 60 t ha^{-1} was recorded highest significant leaf P and K concentration 0.118% and 0.12% at prob<0.05 and prob<0.01 respectively; while control recorded lowest concentration 0.072% and 0.07% respectively. Manures and interaction affected non-significantly on P and K concentration.

These results indicated to increase macronutrient concentration with increased of organic applications and it became lowest without application manures (Casado-Vela et al. 2007; Ewulo et al. 2008).

Table 4.10. Effect of organic fertilizers, application rates and their interaction on N, P and K% in leaves at flowering stage

Manure application rates (t ha^{-1})												
Manures	N%				P%				K%			
	Zero	30	60	Mean	Zero	30	60	Mean	Zero	30	60	Mean
Poultry	1.75 ab	2.43 a	1.64 a-c	1.94 a	0.067 c	0.107 a-c	0.107 a-c	0.093 a	0.057 e	0.096 b-d	0.107 a-c	0.09 b
Cattle	0.46 d	0.87 cd	1.92 ab	1.08 b	0.077 a-c	0.097 a-c	0.120 ab	0.098 a	0.068 de	0.138 a	0.120 ab	0.11 a
Compost	1.10 b-d	1.50 bc	1.63 a-c	1.41 b	0.073 bc	0.103 a-c	0.127 a	0.101 a	0.074 c-e	0.103 a-d	0.126 ab	0.10 ab
Mean	1.10 b	1.60 ab	1.73 a		0.072 b	0.102 a	0.118 a		0.07 b	0.11 a	0.12 a	
LSD 0.05	Manures 0.50	Application 0.50	Interaction N.S		Manures N.S	Application 0.03	Interaction N.S		Manures N.S	Application 0.02	Interaction N.S	
F test	**	*	-		-	*	-		-	**	-	

*: Means value significant at prob≤0.05 **: Means value significant at prob≤0.01 ***: Means value significant at prob≤0.001 N.S: Means value non-significant Means followed by same letter (s) for manures, application rates and interaction are not significantly deferent at LSD 0.05 according to student's t. Fertilizer control and doses control are same.

4.4. Effect of Organic Fertilizers, Application Rates and their Interaction on Physical and Chemical Properties in the Soil.

Table 4.11. showed compost and application 60 t ha^{-1} recorded highest soil nitrogen concentration 0.19% and 0.20% respectively at prob<0.05 and 0.001; while cattle manure and control recorded lowest 0.17% and 0.15%. Interaction was non-significant of N concentration, also show poultry manure, application 60 t ha^{-1} and them interaction recorded highest significant soil available phosphorus concentration 779.35, 768.01 and 2210.93 mg kg^{-1} respectively at prob<0.001; while compost manure, control and Co.M.1 recorded lowest P concentration 37.96, 37.85 and 34.21 mg kg^{-1} respectively. Table 12 show poultry manure, application 60 t ha^{-1} and them interaction recorded highest soil potassium concentration 12.67, 12.66 and 24 mg kg^{-1} respectively at prob<0.001; while compost manure and control recorded lowest K concentration 5.70, 5.88 and 4.47 mg kg^{-1} respectively.

Table 4.12. show compost manure, application 60 t ha^{-1} and them interaction recorded highest soil organic matter 2.91, 3.10 and 3.26% at prob<0.05, prob<0.001 and prob<0.01 respectively; while cattle manure, control and Ca.M.1 recorded lowest soil organic matter 2.66%, 2.56% and 2.43% respectively also this table show soil calcium carbonate recorded non-significant deferent for all treatments.

Table 4.13. show compost manure, application 30 t ha^{-1} and them interaction recorded highest soil pH 7.88, 7.87 and 7.95 at prob<0.001, prob<0.01 and prob<0.001; while respectively poultry manure, control and P.M.2 recorded lowest soil pH 7.75, 7.80 and 7.67 respectively also show poultry manure, application 60 t ha^{-1} and them interaction recorded highest soil electrical conductivity 0.31, 0.32 and 0.41 dm m^{-1} respectively at prob<0.001; while compost manure and control recorded lowest soil EC 0.25, 0.23 and 0.22 dm m^{-1} respectively.

These results showed application manure fertilizers increase soil macro elements, organic matter and EC with increased manure applications; while decrease soil pH with increased manure application (Appireddy et al. 2008; Mahmoud et al. 2009; Chellem and Lazarovit 2002).

Table 4.11. Effect of organic fertilizers, application rates and their interaction on N, P and K in the soil

Manures	Manure application rates (t ha^{-1})											
	N%				**P mg kg^{-1}**				**K mg kg^{-1}**			
	Zero	30	60	Mean	Zero	30	60	Mean	Zero	30	60	Mean
Poultry	0.41	0.19	0.21	0.18 a	35.74 b	91.37 b	2210.93 a	779.35 a	4.47 d	9.53 b	24 a	12.67 a
Cattle	0.15	0.17	0.17	0.17 b	40 b	42.08 b	51.26 b	44.44 b	7.30 b-d	5.7 cd	7.70 bc	6.90 b
Compost	0.16	0.20	0.21	0.19 a	37.82 b	34.21 b	41.86 b	37.96 b	5.86 cd	4.97 cd	6.27 cd	5.70 b
Mean	0.15 b	0.19 a	0.20 a		37.85 b	55.88 b	768.01 a		5.88 b	6.73 b	12.66 a	
L.S.D 0.05	Manures 0.014	Application 0.014	Interaction N.S		Manures 100.59	Application 100.59	Interaction 174.24		Manures 1.68	Application 1.68	Interaction 2.91	
F test	*	***	-		***	***	***		***	***	***	

*: Means value significant at prob≤0.05 **: Means value significant at prob≤0.01 ***: Means value significant at prob≤0.001 N.S: Means value non-significant Means followed by same letter (s) for manures, application rates and interaction are not significantly deferent at LSD 0.05 according to student's t. Fertilizer control and doses control are same.

Table 4.12. Effect of organic fertilizers, application rates and their interaction on O.M% and $CaCO_3$% in the soil

Manures application rates (t ha^{-1})								
Manures	**O.M%**				**$CaCO_3$%**			
	Zero	30	60	Mean	Zero	30	60	Mean
Poultry	2.46 d	2.90 c	3.20 ab	2.85 a	27.5	24.1	24.6	25.4
Cattle	2.69 cd	2.43 d	2.86 c	2.66 b	24.7	26.6	25.6	25.6
Compost	2.54 d	2.92 bc	3.26 a	2.91 a	26.1	25	25.1	25.4
Mean	2.56 c	2.75 b	3.10 a		26.1	25.2	25.1	
L.S.D 0.05	Manures 0.17	Application 1.17	Interaction 0.29		Manures N.S	Application N.S	Interaction N.S	
F test	*	***	**		-	-	-	

*: Means value significant at prob≤0.05 **: Means value significant at prob≤0.01 ***: Means value significant at prob≤0.001 N.S: Means value non-significant Means followed by same letter (s) for manures, application rates and interaction are not significantly deferent at LSD 0.05 according to student's t. Fertilizer control and doses control are same.

Table 4.13. Effect of organic fertilizers, application rates and their interaction on pH and EC dm m^{-1} in the soil

	Manures application rates (t ha^{-1})							
Manures	pH				EC			
	Zero	30	60	Mean	Zero	30	60	Mean
Poultry	7.78 d	7.81 cd	7.67 e	7.75 b	0.24 cd	0.30 b	0.41 a	0.31 a
Cattle	7.83 b-d	7.86 bc	7.89 ab	7.86 a	0.22 d	0.26 b-d	0.27 bc	0.26 b
Compost	7.80 cd	7.95 a	7.90 ab	7.88 a	0.25 cd	0.24 cd	0.28 bc	0.25 b
Mean	7.80 b	7.87 a	7.82 b		0.23 c	0.27 b	0.32 a	
L.S.D 0.05	Manures 0.04	Application 0.04	Interaction 0.07		Manures 0.02	Application 0.02	Interaction 0.04	
F test	***	***	***		***	***	***	

*: Means value significant at prob≤0.05 **: Means value significant at prob≤0.01 ***: Means value significant at prob≤0.001 N.S: Means value non-significant Means followed by same letter (s) for manures, application rates and interaction are not significantly deferent at LSD 0.05 according to student's t. Fertilizer control and doses control are same.

Figure 3.1. Effect of organic fertilizers on 50% blooming P.M.1

Figure 4.1. Effect of organic fertilizers on growth of pepper Co.M.2

Figure 4.2. Effect of organic fertilizers on yield of pepper (left picture P.M.1. and right picture Ca.M.1.)

5. CONCLUSION

These results showed that application rates 30t ha^{-1} poultry manure contributed to increase vegetative growth, yield and number of fruit than other manures; while leaves and soil macro nutrient significantly influenced by application rates 60 t ha^{-1} poultry manure than other manures.

Application of various rates of poultry manures, cattle manure and compost in this study resulted in good stand establishment, plant growth, superior yield and some macro nutrient contents (N, P, and K) of leaves of sweet pepper (*Capsicum annuum* L.). This could be due to the favorable effect of these organic fertilizers on soil physical and chemical properties and their ability to supply essential nutrients necessary for sweet pepper (*Capsicum annuum* L.) growth and development. Without mineral fertilizer application, poultry manures at the rate of 30 t ha^{-1} improved the yield and some physical characters. Application of poultry manures at the maximum rate of 60 t ha^{-1} was increased macro nutrients of pepper (*Capsicum annuum* L.) in greenhouse conditions compared with the cattle manure and compost applications.

Additionally, with rising cost of mineral fertilizers and increasing awareness of the benefits of manures, nowadays crop growers are incorporating organic fertilizers as poultry manure, cattle manure and compost into their farms. The findings of this study will therefore enhance the use of these organic fertilizers especially poultry manures in sweet pepper (*Capsicum annuum* L.) production.

REFERENCES

Abele U, (1987) Produktqualitat and dungung–miniralisch, organisch, biologisch-dynamisch. Schriftenreihe des Bundesministers fur ernahrung, Landwirtschaft und Forsten. Helf 345. Munster Hiltrup

Abu-Zahra TR, (2012) Vegetative, flowering and yield of sweet pepper as influenced by agricultural practices. Department of Plant Production and Protection, Faculty of Agricultural Technology, Al-Balqa' Applied University, As-Salt, 19117, Jordan. Middle East Journal of Scientific Research 11(9): 1220-1225

Adesina JM, Sanni KO, Afolabi L, Eleduma AF, (2014) Effect of variable rate of poultry manure on the growth and yield of pepper (*Capsicum annum* L.) in South Western Nigeria. Academ Arena, 6(1): 9-13

Agusiobo ON, (1976) Vegetable gardening. Macmillan Educ. Pub. p. 65

Aksoy U, (2001) Ecological farming. II. Ecological Farming Symposium in Turkey. 14-16 December. Antalya

Alabi DA, (2006) Effects of fertilizer phosphorus and poultry droppings treatments on growth and nutrient components of pepper (*Capsicum annum* L.). African Journal of Biotechnology Vol. 5(8) pp. 671-677 18 April, 2006. ISSN 1684–5315, Academic Journals

Aliyu L, (2000) Effect of organic and mineral fertilizers on growth, yield and composition of pepper (*Capsicum annum* L.) Biological Agriculture and Horticulture An International Journal for Sustainable Production Systems. ISSN: 0144-8765

Ann YC, (2012) Impact of different fertilization methods on the soil, yield and growth performance of black pepper (*Piper nigrum* L.). Malaysian Journal of Soil Science. Vol. 16: 71-87. ISSN: 1394-7990

Appireddy G.K, Saha S, Mina BL, Kundu S, Selvakumar G, Gupta HS, (2008) Effect of organic manures and integrated nutrient management on yield potential of bell pepper (*Capsicum annuum* L.) varieties and on soil properties. Archives of Agronomy and Soil Science Vol. 54, No. 2, April 2008, 127–137

Arancon NQ, Edwards CA, Bierman P, Metzger JD, Lucht C, (2005) Effect of vermicomposts produced from cattle manure, food waste and paper waste on the growth and of peppers in the field. Pedobiologia 49(2005): 297-306

Awad AM, Tartoura EA, Elfouly HM, Fattah AI, (2002) Response of potato growth, yield and quality to farmyard manure sulphur and gypsum levels application. 2nd Int. Conf. Hort. Sci., 10-12 Sept. Kafr El-Sheikh, Tanta Univ., Egypt, 24-39

Awodun MA, Omonijo LI, Ojeniyi SO, (2007) Effect of goat dung and npk fertilizer on soil and leaf nutrient content growth and yield of pepper. International Journal of Soil Science 2(2): 142-147, ISSN 1816-4978

Carr L, Grover R, Smith B, Richard T, Halbach T, (1995) Commercial and on-farm production and marketing of animal waste compost products. In: Steele, K. (Ed.) Animal Waste and the Land-Water Interface. Lewis Publishers, Boca Raton, pp. 485-492

Casado-Vela J, Selles S, Diaz-Crespo C, Navarro-Pedreno J, Mataix-Beneyto J, Gomez I, (2007) Effect of composted sewage sludge application to soil on sweet pepper crop (*Capsicum annum*. Var annuum) grown under two exploitation regimes. Waste Management 27(2007) 1509-1518.

Chang C, Cho CM, Janzen HH, (1998) Nitrous oxide emission from long-term manures soils. Soil Sci. Soc. Am. J. 62: 677-682

Chellem DO, Lazarovits G, (2002) Effect of organic fertilizer applications on growth, yield and pests of vegetable crops. London Ontario, Canada, N 5, V 4, T 3. Proc. Fla. State Hort. Soc. 115: 315-321

Chowdhury R, (2004) Effects of chemical fertilizers on the surrounding environment and the alternative to the chemical fertilizers. IES- ENVIS NEWSLETTER. 7(3): 4-5

Delate K, Camberdell CA, (2004) Agro-Ecosystem performance during transition to certified organic grain production. Agron. J. 96(5): 1288-1298

Eghball B, Power JF, (1999) Composted and noncomposted manure application to conventional and no-tillage systems: corn yield and nitrogen uptake. Published in Agron. J. 91: 819–825

Eghball B, Power JF, Gilley JE, Doran JW, (1997) Nutrient, carbon, and mass loss of beef cattle manure during composting. J. Environ. Qual. 26: 198-193

Ewulo BS, Ojeniyi SO, Akanni DA, (2008) Effect of poultry manure on selected soil physical and chemical properties, growth, yield and nutrient status of tomato. African Journal of Agricultural Research. Vol. 3(9): pp. 612-616, September 2008. ISSN 1991-637X

Fajinmi AA, Odebode CA, (2007) Effect of Poultry Manure on Pepper Veinal Mottle Virus (PVMV), Yield and Agronomic Parameters of Pepper (*Capsicum annum*) in Nigeria. East Africa Journal of Sciences. Volume 1(2): 104-111

Farhad W, Saleem MF, Cheema MA, Hammad HM, (2009) Effect of poultry manure levels on the productivity of spring maiz (*Zea mays* L.). Anim. Plant Sci. J. 19(3): 122-125

Ghoname A, Shafeek MR, (2005) Growth and productivity of sweet pepper (*Capsicum annum* L.) grown in plastic house as affected by organic, mineral and Bio-N-Fertilizers. National Research Senter, Department of Vegetable Research, El-Tahrir St., Dokki. Cairo, Egypt. Asian Network for Scientific Information. Journal of Agronomy 4(4): 396

Ghorbani I, Koocheki A, Jahan M, Asadi GA, (2008) Impact of organic amendments and compost extracts on tomato production and storability in agroecological systems. Agronomy for sustainable development. 28(2008): 307–311

Hallmann E, Rembialkowska E, (2012) Characterization of antioxidant compounds in sweet bell pepper (*Capsicum annum* L.) under organic and conventional growing systems. J Sci Food Agric 92(12): 2409-2415

Hao X, Chang C, Travis GR, Zhang F, (2003) Soil carbon and nitrogen response to 25 annual cattle manure applications. J. Plant Nutr. Soil Sci. 166, 239-245

Hargreaves J, Adl M, Warman P, (2008) A Review of the use of composted municipal solid waste in agriculture. Agric. Ecosyst. Environ. 123, 1–14

Hutchison ML, Walters LD, Avery SM, Munro F, Moore A, (2005) Analyses of livestock production, waste storage, and pathogen level and prevalence's in farm manures. Appl. Environ. Microb. 71, 1231-1236

Ikeh AO, Ndaeyo NU, Akpan EA, Udoh EI, Akata OR, (2013) Evaluation of complementary use of organic manure for sustainable water yam production in Uyo, South-Eastern Nigeria. American Journal of Research Communication. 1(2): 33-48 ISSN: 2325-407

Ikeh AO, Ndaeyo NU, Uduak IG, Iwo GA, Ugbe LA, Udoh EI, Effiong GS, (2012) Growth and yield responses of pepper (*Capsicum frutescens* L.) to varied poultry manure rates in uyo, South-Eastern Nigeria. ARPN Journal of Agricultural and Biological Science. VOL. 7, NO. 9, Sep

Jigme, Jayamangkala N, Sutigoolabud P, Inthasan J, Sakhonwasee S, (2015) The effect of organic fertilizers on growth and yield of broccoli (*Brassica oleracea* L. var. italica plenck cv. top green). Journal of Organic Systems, 10(1)

Kacar B, (1972) Bitki ve toprağın kimyasal analizleri. Ankara Üniv. Ziraat Fak. Yayınları: 453, Ankara

Keshinro OO, Ketiku OA, (1983) Contribution of tropical chillies to ascorbic acid consumption. Food Chem. 11: 43-49

Lazcano C, Gomez-Brandon M, Dominguez J, (2008) Comparison of the effectiveness of composting and vermicomposting for the biological stabilization of cattle manure. Chemosphere 72(2008) 1013–1019

Liu T, Chen X, Hu F, Ran W, Shen Q, Li H, Whalen jk, (2016) Carbon-rich organic fertilizers to increase soil biodiversity: evidence from a meta-analysis of nematode communities. Agriculture, Ecosystems & Environment, Vol. 232, Issue null, P. 199-207

Maerder P, FlieBbach A, Dubois D, Gunst L, Friend P, Niggli U, (2002) Soil fertility and biodiversity in organic farming. Science 296, 1694-1697

Mahmoud E, Abd EL-Kader N, Robin P, Akkal-Corfini N, Abd El-Rahman L, (2009) Effects of different organic and inorganic fertilizers on cucumber yield and some soil properties. World Journal of Agricultural Sciences 5(4): 408-414, 2009. ISSN 1817-3047

Mehdizadeh M, Darbandi EI, Naseri-Rad H, Tobeh A, (2013) Growth and yield of tomato (*Lycopersicon esculentum* mill.) as influenced by different organic fertilizers. International Journal of Agronomy and Plant Production. Vol., 4(4): 734-738

Moore Jr. PA, Daniel TC, Sharpley AN, Wood CW, (1995) Poultry manure management: environmentally sound options. Journal of Soil and Water Conservation May-June, vol. 50(3): 321-327

Olaniyi JO, Ojetayo AE, (2010) The effect of organ mineral and inorganic fertilizers on the growth, fruit yield and quality of pepper (*Capsicum frutescence*). J. Animal & Plant Sciences, 8(3): 1070-1076

Olaofe OJ, Mustapha, Ibiyemi SA, (1993) Amino acid and mineral composition of some Nigerian Chillies Trop. Sci. 33(3): 226-231

Power ed. JE, (1987) The role of legumes in conservation tillage systems. Ankeny, IA: Soil and Water Conservation Society. pp. 25-29

Rine J, Istifan J, Abd-Alrashid, (2003) Soil and plant analysis. International Canter for Agricultural Research in the Dry Areas (ICARDA) and the National Canter for Agricultural Research (NARC). ISBN: 5-144-9127-92

Risse LM, Cabrera ML, Franzluebbers AJ, Gaskin AJ, Gilley GE, Killorn R, Radcliffe DE, Tollner WE, Zhang H, (2006) Land application of manure for beneficial reuse. pp. 283-316. In: J.M. Rice, D.F. Caldwell and F.J. Humenik (eds). Animal Agriculture and the Environment. ASABE. Pub. Number 913C0306. St. Joseph, Michigan

Shahein MM, El Sayed SF, Hassan HA, Abou-El-Hassan S, (2015) Producing sweet pepper organically using different sources of organic fertilizers under plastic house conditions. International Conference on Advances in Agricultural, Biological & Environmental Sciences (AABES-2015) July 22-23, 2015 London (UK)

Silva TRB, Bortoluzzi T, Silva CAT, Arieira CR, (2012) A Comparison of poultry litter applied like organic fertilizer and that applied like chemical fertilizer in corn development. Afr. J. Agric. Res. 7(2): 194-197

Stadler C, (2011) Effect of organic fertilizers on n mineralization, growth and yield of year-round organic greenhouse cucumber and sweet pepper. Landbunaoarhaskoli Islands. Rit LbhI nr. 32. Jan

Stute JK, Posner JL, (1993) Legume cover crop options for grain rotations in Wisconsin. Agron. J. 85: 1128-1132

Suge JK, Omunyin ME, Omani EN, (2011) Effect of Organic and Inorganic Sources of Fertilizer on Growth, Yield and Fruit Quality of Eggplant (*Solanum melongena* L). Arch. Appl. Sci. Res., vol. 3, no. 6, pp. 470-479

Sullivan D, Bary A, Nartea T, Myrhe E, Cogger C, Fransen S, (2003) Nitrogen availability seven years after a high-rate food waste compost application. Compos. Sci. Util. 11, 265–275

Sullivan D, Bary A, Thomas D, Fransen S, Cogger C, (2002) Food waste compost effects on fertilizer nitrogen efficiency, available nitrogen, and tall fescue yield. Soil Sci. Soc. Am. J. 66, 154–161

Sweeten JT, (1988) Composting manure and sludge. P. 38-44. In Proc. of the National Poultry Waste Management Symposium. Columbus, OH. 18-19 Apr. Ohio State University, Columbus

Teasdale JR, (1996) Contribution of cover crops to weed management in sustainable agricultural systems. J. Prod. Agric. 9: 475-479

USD. of Agriculture. Table 64: (2008a) World bell and chilli peppers, production, 1990-2007. Econ. Res. Serv., U.S. Dept. Agr. Economics, Statistics and Market Information System. United Nations, Food and Agriculture Organization, FAO Stat. 5 Nov

USDA Agricultural Marketing Service, (2016) Specialty crops market news

Villar MC, Beloso MC, Acea MJ, Cabaneiro A, Gonzalez-Prieto SJ, Diaz-Ravina M, Carballas T, (1993) Physical and chemical characterization of four composted urban refuses. Bio resource Technol. 45, 105-113

Wilkinson SR, (1997) Plant nutrient and economic value of animal manures. Journal of Animal Science 48: 121-133

Yanar D, Geboloğlu N, Yanar Y, Aydın M, Çakmak P, (2011) Effect of different organic fertilizers on yield and fruit quality of indeterminate tomato (*Lycopersicon esculentum*). Scientific Research and Essays Vol. 6(17), pp. 3623-3628, 26 August

Zayed MS, Hassanein MKK, Esa NH, Abdallah MMF, (2013) Productivity of pepper crop (*Capsicum annum* l.) as affected by organic fertilizer, soil solarisation, and endomycorrhizae. Faculty of Agriculture, Ain Shams University. Annals of Agricultural Science. (58)2: 131-137

Zublena JP, Barker JC, Carter TA, (1997) Poultry manure as a fertilizer source. p: north carolina cooperative extension service. No. AG-439-5

BACKGROUND

She was born in Iraq's Sulaymaniyah in 1976. She completed her primary and secondary school education in Sulaymaniyah. In 1995 she was placed at Sulaymaniyah University Faculty of Agriculture. She was graduated from the Sulaymaniyah University Faculty of Agriculture Department of Soil in 2000. She was appointed as an Agriculture Engineer at Sulaymaniyah Agricultural Research Institute in 2001. She enrolled at the Postgraduate Program in Bingöl University Institute of Science Department of Soil Science in 2015.