INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 4, No. 2, p. 120-124, 2014

RESEARCH PAPER OPEN ACCESS

Vegetative growth of apple tree as affected by irrigation frequency and chicken manure rate

Sako Kakehzadeh, Shahram Sharafzadeh*, Bahram Amiri

Department of Agriculture, Firoozabad Branch, Islamic Azad University, Firoozabad, Iran

Key words: Organic fertilizer, orchard, sustainable agriculture, water needs.

http://dx.doi.org/10.12692/ijb/4.2.120-124 Article published on January 18, 2014

Abstract

The optimum water requirements for trees are important to ideal growth and the manures are important sources of nutrients for sustainable crop production. This experiment was conducted by using irrigation frequency (3, 5, 7, 10 days, irrigation intervals) as main factor and chicken manure rates (0, 0.5, 0.7, 1.0 and 1.2 kg/tree) as minor factor in a split plot experiment based on randomized complete block design with three replications on apple trees of cv. Golden delicious. The results indicated that the frequency of irrigation and chicken manure rates altered vegetative growth characteristics of apple trees significantly. Seven days intervals of irrigation resulted in the best growth characteristics. Application of chicken manure at 0.5 kg /tree can be recommended as a suitable rate.

* **Corresponding Author:** Shahram Sharafzadeh ✉ shahramsharafzadeh@hotmail.com

Introduction

Golden delicious apple trees have middle vigour, the most cultivated apples and form thick crowns. It is productive and for a good quality of the fruit it has to be planted in regions with small atmospheric humidity. The fruits have an average size, spherical, green-yellowish at harvesting and then reaching a golden yellow at the consumption maturity with sweet taste (Eva and Mariana, 2010). Apple trees can acclimate to different environmental conditions and they are cultivated on every continent on the world except in very cold conditions. The nutrients requirements depend on species, age and climatic conditions (Hangan and Fit, 2010).

The optimum water requirements for trees are important to ideal growth. This helps improve irrigation efficiency and reduce costs associated with water losses. In order to evaluate the response of trees to different irrigation treatments at the same location, either the trunk or main branches may be used (Wiegand and Swanson, 1982).

Fertility systems of tree orchards depend on the age of the trees, the depth of the trophic layer, the content of humus and clay in the soil (Valentina and Braniste, 2000). Because of food and environmental safety, organic apple production has revealed significant growth during recent years in order to decrease application of synthetic materials such as fertilizers (TerAvest *et al.*, 2010). The organic fertilizers up the mineral fertilizers affect on soil fertility and enhance and maintain this quality to production of crops (Hangan and Fit, 2010). Organic agriculture is a new system to avoid the use of chemical and synthetic fertilizers. Environmental influences on human health courage growers to convert to organic production (Fayed, 2005). Integrating livestock and crop production can improve soil fertility by using on-farm resources of animal manures (Hilimire *et al.*, 2012).

Manures are important sources of nutrients for sustainable crop production. Managing the nutrients of orchard floor is an important problem for organic growers (Andrews, 2002). The low input of organic matter to soil and the intensive management of the orchards result in the reduction of organic matter content and quality of the soil (Canali *et al.*, 2002). As a standard, organic growers can use natural methods and products. They consider soil organic matter as the foundation for their farms because of releasing nutrients slowly over the time through mineralization. Chicken manure compost is relatively rich in nitrogen content and has a low cost per pound of nitrogen (Granatstein, 2003). Reports suggest that application of poultry manure can improve chemical, biological and physical quality, and plant growth (Hilimire *et al.*, 2012). Manure contains beneficial organic matter and many macro and micronutrients. The organic nitrogen in manure is mineralized over the time and providing nitrogen for several years. Chicken manure contains both organic and inorganic forms of the plant nutrients. Nutrients present in the inorganic form can readily available to plants whereas organic nutrients become available as the manure decomposes, but may not be available until the next season (McCall, 1980).

The growth of various tree organs during each season results in the total growth rate of a tree so it is important to study the growth patterns and growth rates of the various tree organs (Kanber *et al.*, 1999). The objective of this study was to evaluate the effects of irrigation frequency and level of chicken manure on vegetative growth characteristics of young apple trees.

Materials and methods

Plant materials and experimental conditions

The study was conducted on one year old apple trees of cv. Golden delicious grafted on seedling rootstocks, by using irrigation frequency (3, 5, 7, 10 days, irrigation intervals) as main factor and chicken manure rates (0, 0.5, 0.7, 1.0 and 1.2 kg/tree) as minor factor in a split plot experiment based on randomized complete block design (RCBD) with three replications at an orchard in Mahabad, West Azarbayjan Province, Iran. The trees were under furrow irrigation system and planted at 6 X 6 m apart

and received the common horticultural practices. Before beginning of the experiment, in the first season, the irrigation interval was seven days. The analysis of the chicken manure showed N=3.96%, P=1.41%, K=1.57%, organic C= 36.5%, pH=5.92, EC=15.64 ds/m, Fe=1087 ppm, Mn=369 ppm, Zn=400 ppm and Cu=29 ppm. Chicken manure treatments were carried out by digging a 20 X 30 cm hole with the 15 cm depth and 20 cm distance from the tree at second season before beginning of tree growth. Bud number, trunk diameter, annual shoot length, tree height and crown diameter were measured at the beginning and also end of the growth at the second season to determine increasing in vegetative characteristics of the trees.

Statistical analysis

Data from the experiment were subjected to analysis of variance (ANOVA) using SPSS computer software and the means compared with Duncan's new multiple range test (DNMRT) at $P < 0.05$.

Results and discussion

The results indicated that the frequency of irrigation altered vegetative growth characteristics of apple trees (Table 1). The maximum increase of bud number (21.73) was obtained at 5 days irrigation intervals. The highest increase of trunk diameter (2.70 cm), annual shoot length (30.23 cm), height of the tree (79.73 cm) and crown diameter (21.60 cm) were achieved on 7 days intervals.

Table 1. Effect of frequency of irrigation on growth characteristics of apple tree.

Irrigation intervals (day)	increased bud number	increased trunk diameter (cm)	increased annual shoot length (cm)	increased tree height (cm)	increased crown diameter (cm)
3	15.4 b	2.47 ab	24.41 a	72.33 ab	19.43 ab
5	21.73 a	1.73 b	14.90 b	72.27 ab	21.57 a
7	11.53 b	2.70 a	30.23 a	79.73 a	21.60 a
10	13.60 b	1.83 ab	14.83 b	70.27 b	17.60 b

In each column, means with the same letters are not significantly different at 5% level of Duncan's new multiple range test.

Chicken manure affected on vegetative growth characteristics (Table 2). The maximum increase of bud number (19.25) was obtained at 0.7 kg/tree which was significantly different when compared to control (0 kg/tree). The highest increase of trunk diameter (2.63 cm), annual shoot length (28.68 cm), height of the tree (81.67 cm) and crown diameter (22.58 cm) were achieved on 1.0 kg/tree which were not significantly different when compared to 0.5 and 0.7 kg/tree.

Table 2. Effect of chicken manure on growth characteristics of apple tree.

chicken manure (kg/tree)	increased bud number	increased trunk diameter (cm)	increased annual shoot length (cm)	increased tree height (cm)	increased crown diameter (cm)
0	7.17 b	1.29 b	9.19 c	57.58 b	16.21 b
0.5	18.17 a	2.29 a	20.68 ab	74.17 a	20.75 a
0.7	19.25 a	2.38 a	28.20 ab	79.58 a	20.75 a
1.0	16.58 a	2.63 a	28.68 a	81.67 a	22.58 a
1.2	16.67 a	2.33 a	18.71 b	75.25 a	19.96 a

In each column, means with the same letters are not significantly different at 5% level of Duncan's new multiple range test.

Poultry manures contain two to three times as much nitrogen, three to five times as much phosphorus and about the same amount of potassium as other farm manures. In addition, chicken manure is an important soil conditioner, and it increases the soil's moisture-holding and nutrient-holding capacities (McCall, 1980).

The present results are in accordance with those obtained by El-Morshedy (1997) who found that, chicken manure increased shoot growth rate of sour orange seedlings.

Researchers suggested a positive effect of the poultry manure treatments on soil humification (Canali *et al.*, 2004).

AL-Kahtani and Ahmed (2012) revealed that the agricultural waste + 10% sheep manure resulted in the highest values of all vegetative growth parameters of olive tree such as leaf length, width and area, shoot length and pigments content.

Manures can provide high concentrations of mineral nutrients, especially nitrogen, however the nitrogen of the manure can be lost via volatilization therefore, manures are suitable to groundcover management systems utilizing cultivation. Manures provide multiple nutrients in addition to nitrogen. For example chicken manure is high in phosphorous (Schupp and Moran, 2003).

The results of using manure are variable due to variation in nutrient content or degree of decomposition. Organic matter is often low in many existing orchard soils, and increasing it improves soil water and nutrient holding capacity which improves root regeneration and tree vigor.

Conclusion

Apple growers need to determine the optimum irrigation frequency and chicken manure rates. Under present experimental conditions, 7 days intervals for irrigation resulted in the best growth characteristics. There were not significant differences between 0.5-1.0 kg chicken manure/tree regarding the vegetative growth characteristics therefore, 0.5 kg/tree can be recommended as a suitable rate.

References

AL-Kahtani SH, Ahmed MA. 2012. Effect of different mixtures of organic fertilizers on vegetative growth, flowering, fruiting and leaf mineral content of picual olive trees. American-Eurasian Journal of Agriculture and Environmental Science **12(8),** 1105-1112.

Andrews P. 2002. Nutrient management in organic apple orchards. Presented at the International Symposium on Apples in Cuauhtémoc, Mexico, 2002.

Canali S, Trinchera A, Di Bartolomeo E, Nisini L, Benedetti A, Intrigliolo F. 2002. Soil fertility comparison among organic and conventional managed citrus orchards in Sicily. Tran. of 17th World Congress of Soil Science. Bangkok (Thailand) 14-21 August. Paper n. 1197 (CD-ROM).

Canali S, Trinchera A, Intrigliolo F, Pompili L, Nisini L, Mocali S, Torrisi B. 2004. Effect of long term addition of composts and poultry manure on soil quality of citrus orchards in Southern Italy. **40(3),** 206-210. Biology and Fertility of Soils. http://dx.doi.org/10.1007/s00374-004-0759-x

El-Morshedy FA. 1997. Organic manure and sulphur interaction influence vegetative growth and element concentration of sour orange seedlings. Journal of Agricultural Science, Mansoura University **22,** 4599-4614.

Eva B, Mariana P. 2010. The influence of fertilization with chemical fertilizers on phosphorus and potassium present in the apple tree leaves. Analele UniversităŃii din Oradea Fascicula: Ecotoxicologie, Zootehnie si Tehnologii de Industrie Alimentară.

Fayed TA. 2005. Effect of some organic manures and biofertilizers on Anna apple trees. 2-Yield and fruit characteristics. Egyptian Journal of Applied Science **20(1),** 176-191.

Granatstein D. 2003. Tree Fruit Production with Organic Farming Methods. Wenatchee (WA): Center for Sustaining Agriculture and Natural Resources, Washington State University. Retrieved from:

http://organic.tfrec.wsu.edu/OrganicIFP/OrganicFruitProduction/OrganicMgt.PDF)

Hangan MC, Fit EM. 2010. The effect of differential fertilization upon golden delicious and starkrimson apples production on typical preluvosol soil. Research Journal of Agricultural Science **42(3)**, 167-171.

Hilimire K, Gliessman SR, Muramoto J. 2012. Soil fertility and crop growth under poultry/crop integration. Renewable Agriculture and Food Systems.
http://dx.doi.org/10.1017/S174217051200021X

Kanber R, Köksal H, Yazar A, Özekici B, Önder S. 1999. Effects of different irrigation programs on fruit, trunk growth rates, quality and yield of grapefruit trees. Turkish Journal of Agriculture and Forestry **23,** 401-411.

McCall WW. 1980. Chicken Manure. Retrieved from: S-02. pdf.

http://www.ctahr.hawaii.edu/oc/freepubs/pdf/GHG

Schupp J, Moran R. 2003. Mineral nutrient management for organic fruit production. Retrieved from:
http://www.massfruitgrowers.org/nefrtmtg/proc-2003D/mineral_nutrient_management.pdf

TerAvest D, Smith JL, Carpenter-Boggs L, Hoagland L, Granatstein D, Reganold JP. 2010. Influence of orchard floor management and compost application timing on nitrogen partitioning in apple trees. HortScience **45(4),** 637-642.

Valentina A, Braniste N. 2000. Cultura marului, Editura Ceres Bucuresti**.** 90 p. ISBN 973-999540-5-7.

Wiegand CL, Swanson WA. 1982. Citrus response to irrigation. III Tree trunk and canopy growth. Journal Rio Grande Valley Horticultural Society **35**, 97-107.