# Asian Journal of Plant Sciences

ISSN 1682-3974

science alert

ANSInet
an open access publisher
http://ansinet.com

Asian Journal of Plant Sciences 9 (6): 380-384, 2010
ISSN 1682-3974


# Effects of Water of Different Quality on Tomato Growth and Development

[1]M. Takase, [2]J.D. Owusu-Sekyere and [2]L.K. Sam-Amoah
[1]Agri-Business Unit, E. P. University College, Ho, Ghana
[2]Department of Agricultural Engineering, University of Cape Coast, Cape Coast, Ghana

**Abstract:** This study was conducted to examine the effects of four sources of water on the growth of tomato (*Lycopersicon esculentum*) at Kpong in the Manya Krobo District of Eastern Region in Ghana. The sources of irrigation water were: river, canal, tap and well. The quality of these sources was monitored for a period of five months (August-December 2007). Sampling of the water was done every 6 days in each month. Samples from each of the source taken were sent to the laboratory for analysis. Each water source was used to irrigate tomatoes planted in the field using Randomized Completely Block Design (RCBD) as the experimental design for a period of three month. The treatments were four (river, canal, tap and well) with four replications. During the growing period, soil fertility status was monitored for a period of three months. This was done by taking two core samples from each of the plots before planting of the tomato and subsequent samples taken at the same spots monthly, after planting, for a period of three months and sent for analysis. During this period, plant height, number of flowers and fruits were determined. Weights of fruits were determined in the third. River water proved be the most preferred source for irrigation by virtue of the fact that its plants heights were higher, number of fruits were more than the other sources as well as the weightier mean number of the fruits obtained from the plants.

**Key words:** Salinity, fallow, replication, pricking-out, transpiration

## INTRODUCTION

Water research studies in Ghana clearly showed sever deterioration of water quality in certain areas of the country with adverse effect on crop growth (Karikari and Ampofo, 2006). Therefore, the scientifically applied research program related to water quality, conservation and salinity in agriculture is essential, where agricultural activities account for more than 80% of the total water consumed.

Irrigation water, whether of good quality or not, can have effects on plant growth. For example, poor irrigation water quality with excess salts can damage plants in a variety of ways, but the most common problems are caused by the salts affecting the osmotic relationship between roots and the soil moisture (Malash *et al*., 2005; AbdelGawad *et al*., 2005). Salinity of water is the most important parameter used in determining the suitability of water for irrigation purposes. The salinity effects are generally evidenced by reduced transpiration and proportionally retarded growth, producing smaller plants with fewer and smaller leaves (Rhoades, 1992). In tomato, excess of salts will affect the uptake of nutrients from the soil by the tomato and may also alter the soils ability to retain nutrients-the effect is the suppression of the plant growth (Guodie, 1991). Poor water quality (water with high amount of salt) can hinder the conversion of ammonium salts (in artificial fertilizers) to nitrate by nitrifying micro-organisms in the soil when used for irrigation. Most tomato plants are more sensitive to salts during seed germination, seedling growth and when flowering or fruiting. The seed and seedling stages are vulnerable not only because the plant structures are immature and delicate, but also because tiny root systems draw moisture and nutrients from near the soil surface where salts tend to concentrate (Breckle, 1995).

Increase in tomato production is attempted through improved irrigation, introduction of high yielding varieties, improving the quality of irrigation water, addition of fertilizer and more efficient control of pests. According to Qasem and Judah (1985), the contribution from traditional farmers for tomato production is not optimal because most of them can not afford modern technology and expensive chemical inputs. It has seldom been possible to identify the right source of water for irrigating tomato in order to improve its production.

This study is part of a research work conducted on the use of four sources of water for irrigation of tomato. It specifically report on the best among four sources of water (river, canal, tap and well) used for irrigating tomato in Manya Krobo District of Eastern Region by determining the effects the different sources of water had on growth and development of tomatoes.

**Corresponding Author:** M. Takase, Agri-Business Unit, E.P. University College, Ho, Ghana

## MATERIALS AND METHODS

**The research location:** The study was carried out at Kpong in the Manya Krobo District of Eastern Region.

**Vegetation of the site:** The site had vegetation described as coastal thicket with the presence of forest perennials and annual herbs. The experimental site was previously cropped to pepper and had been left to fallow for one year.

**Experimental design:** The Randomized Completely Block Design (RCBD) was used. Four water treatments namely: river, tap, well and canal water were used. The size of the experimental unit was 16×16 m. There were four plots of sizes 4×4 m with four replications. There were 30 plants on each plot with a total plant population of 480. The plants were spaced 75×100 cm.

**Plant identification:** Five plants on each plot were sampled and tagged with plastic material for data collection.

**Land preparation:** The land was cleared and ploughed in August, 2007. Harrowing was done in September, 2007 to remove any unwanted weeds, debris and to level the land for good seedling establishment.

**Planting materials:** The variety of tomato used was *Wosowoso*. Seeds were bought from a certified seed seller at Kpong market.

**Nursing and transplanting:** Tomato seeds were nursed on raised beds in September, 2007 after which a shade was raised using palm fronds to protect the seeds from excessive sunshine. The seeds started germinating on the 5th day. Pricking out was done after one week. The seedlings were transplanted to the experimental field in the 3rd week.

**Weeding:** Weeding was done with hoes and cutlasses on four occasions which were:

- 1st weeding--- 1st week after transplanting
- 2nd weeding--- before flowering of the tomato
- 3rd weeding--- after flowering of the tomato
- 4th weeding--- during fruiting

**Data collection:** The data was collected on the following growth and development parameters monthly:

- A Plant height (cm)
- B Number of flowers
- C Number of fruits
- D Fruit weight (g)

Plant growth and development data were taken on the sampled tagged plants monthly for three months.

## MEASUREMENT OF THE GROWTH PARAMETERS

The following plant growth and development parameters were measured:

**plant height:** The plant heights were measured with a tape from the base of the plant to the tip of the plant.

**Number of flowers per plant:** The numbers of flowers were counted when the tomato started bearing flowers.

**Number of fruits per plant:** The numbers of fruits were counted when the plants started fruiting.

**Fruit weight:** The fruit weights were determined after harvesting the tomato using a weighing balance.

**Irrigation scheduling:** Irrigation interval was one day; this was done from the day of transplanting to harvesting. Irrigation was given manually using watering can and measuring cylinders. 400-600 mm was irrigated per plant and a total of 12000-9000 mm per plot.

**Amount of water applied:** The amount of water applied to the tomato was according to Silva and Maroucelli (1996). According to their research on tomato crop, water requirement should be between 400-600 mm per plant for tomato in the field for 90 to 120 days.

**Data analysis:** The MstatC software was used for analysis of variance (ANOVA) of data and mean comparison was done using Duncan's Multiple Range Test.

**Treatments:** The treatments comprised irrigating with the following:

(I) River water ($T_1$)
(II) Canal water ($T_2$)
(III) Tap water ($T_3$)
(IV) Well water ($T_4$)

## RESULTS AND DISCUSSION

**Plant height:** Mean plant height over the three month is shown in Fig. 1; the maximum height was obtained from tomato irrigated with $T_1$. Tomato irrigated with $T_4$ resulted

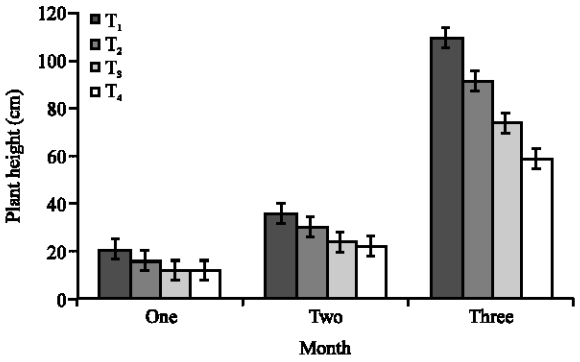


Fig. 1: Variation in plant height over three months with error bars as LSD (p<5%)

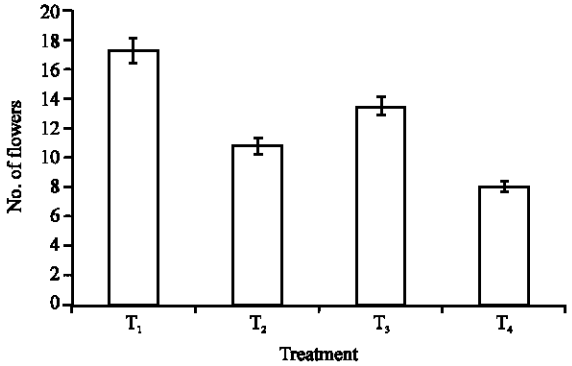


Fig. 2: Variation in number of flowers with error bars as LSD (p<5%)

in the lowest plant height. There were however, significant differences between the mean plant heights in the treatments.

**Number of flowers:** Plants irrigated with $T_1$ recorded a higher mean number of flowers than the plants irrigated with $T_2$, $T_3$ and $T_4$. The least mean number of flowers was obtained from plants irrigated with $T_4$. The mean number of flowers obtained by plants irrigated with $T_1$ was significantly different from the plants irrigated with $T_2$, $T_3$ and $T_4$ (Fig. 2).

**Number of fruits:** Plants irrigated with $T_1$ recorded the highest mean number of fruits. This was followed by the plants irrigated with $T_3$ and the least mean number of fruits obtained from plants irrigated with $T_4$ (Fig. 3).

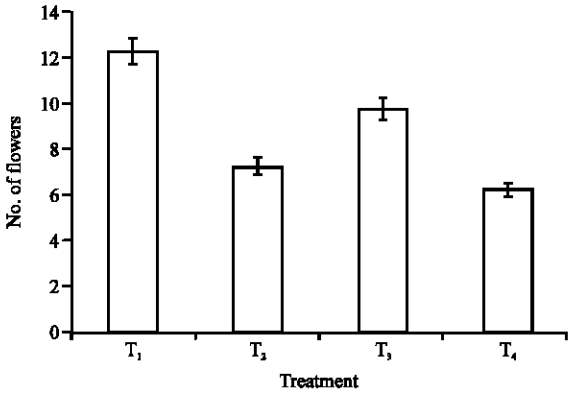


Fig. 3: Variation in number of fruits with error bars as LSD (p<5%)

**Fruit weight:** The highest mean fruit weight was obtained from plants irrigated with $T_1$. $T_4$ plants registered the least mean fruit weight (41.2 g). The differences in the mean weights were significantly different (Fig. 4).

The study indicated significant differences in mean plant height, number of flowers, number of fruits and fresh fruit weight. $T_1$ had low salinity problem. Significant decrease in plant growth as expressed in terms of plant height of tomato with increase in salinity levels in irrigating water is evident in this study (Fig. 1). In this study and in agreement with previous studies, salinity reduced plant height (Achilea, 2002; Agong *et al*., 2004; Hajer *et al*., 2006). Hajer *et al*. (2006) have also reported reduction in plant height, fresh and dry vegetative biomass in three tomato cultivars grown under sea water salinity. Amini and Ehsanpour (2006) have reported reduction in vegetative growth of tomato with increasing salinity.

Plants irrigated with $T_1$ recorded mean flower number of 16 and a mean fruit number of 13. The mean number of

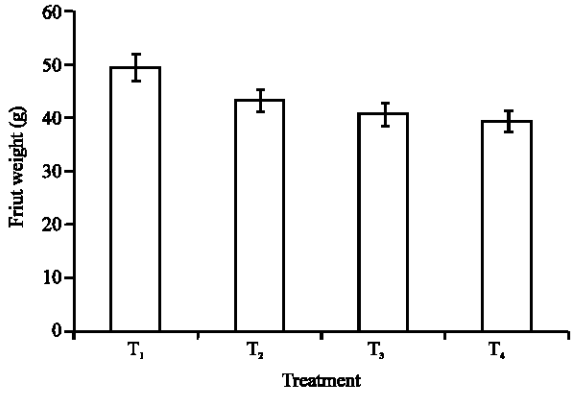


Fig. 4: Variation in fruit weight in the third month with error bars as LSD (p<5%)

flowers obtained by tomato grown using $T_2$ and $T_3$, was 11 and 14, respectively whilst the mean number of fruits for $T_2$ and $T_3$ was 8 and 10, respectively. It can be observed that tomato yield (mean number of fruits) was highest in plants irrigated with $T_1$. This was followed by

tomato irrigated with $T_3$, $T_2$ and the least yield obtained from tomato irrigated with $T_4$ (Fig. 2-3). Plants irrigated with $T_4$ recorded salinity problem that indicated there were some restrictions on its use for irrigation (APHA, 1990). It can therefore be deduced that salt accumulation in the field of $T_4$ irrigated tomato was an important factor in reducing yield in the season which is in contrast with study reported by Wan *et al.* (2007) that salinity had little effect on tomato yield. However, as Shalhevet (1994) stated that it is still controversial whether the reduction in water uptake with increasing salinity is the cause or the result of reduction in growth.

The highest mean fresh fruit weight was also obtained from tomato grown with $T_1$. In agreement with previous studies, salinity reduced tomato fresh fruit weight (Hassan, 1999; D'Amico *et al.*, 2003; Hajer *et al.*, 2006) as well as dry weight (Yurtseven *et al.*, 2005).

Boamah (2004) used tap, pond and well water to irrigate tomato in the Cape Coast District of Central Region in Ghana to determine the most suitable water for growing tomato. In that study, tomatoes irrigated with well water recorded higher number of fruits than those irrigated with tap. The finding in the current study is quite different from Boamah's. In this study, tomato irrigated with well water rather yielded fewer mean number of fruits (6) whilst those irrigated with tap recorded higher mean number of fruits (10).

## CONCLUSION

There were significant differences in the plant height, number of fruits and the fruit weight. Tomato irrigated with river water recorded higher mean number of fruits and higher mean fruit weight. It can therefore be concluded that river water will be the best option for growing tomatoes in the Manya Krobo District of the Eastern Region in Ghana.

## REFERENCES


APHA, 1990. American Public Health Association-Standard Methods for the Examination of Water and Wastewater. 15th Edn., APHA-AWWA-WPCF, Washington, DC., pp: 1000.

AbdelGawad, G., A. Arslan, A. Gaihboe and F. Kadour, 2005. The effects on saline irrigation water management and salt tolerant tomato varieties on sustainable production of tomato in Syria (1999-2002). Agric. Water Manage., 78: 39-53.

Achilea, O., 2002. Alleviation of salinity induced stress in cash crops by Multi K (Potassium Nitrate), five cases typifying the underlying pattern. Acta Hortic., 573: 43-48.

Agong, S.G., Y. Yoshida, S. Yazawa and M. Masuda, 2004. Tomato response to salt stress. Acta Hortic., 637: 93-97.

Amini, F. and A.A. Ehsanpour, 2006. Response of tomato cultivars to MS, water agar and salt stress *in vitro* culture. Pak. J. Biol. Sci., 9: 170-175.

Boamah, P., 2004. The Use of Three Sources of Water to Irrigate Tomato. Project Work Submitted to the Department of Agric Engineering, School of Agriculture, University of Cape Coast, South Africa.

Breckle, S.W., 1995. The Significance of Salinity in Water, Desertification and Development. Dryland Ecology in Social Perspective, Academic Press, London and New York, pp: 277-292.

D'Amico, M.L., R. Izzo, F. Tognoni, A. Pardossi and F. Navari, 2003. Application of diluted Seawater to soilless culture of tomato (*Lycopersicon esculentum* Mill.): Effect on plant growth,yield and fruit quality and antioxidant capacity. J. Food Agric. Environ., 1: 112-116.

Guodie, A.S., 1991. The Human Impact: Man's Role in Environmental Change. Blackwell Publishing Press, Oxford, England.

Hajer, A.S., A.A. Malibari, H.S. Al-Zahrani and O.A. Almaghrabi, 2006. Responses of three tomato cultivars to seawater salinity 1. Effect of salinity on the seedling growth. Afr. J. Biotechnol., 5: 855-861.

Hassan, E.H.A., 1999. Physiological studies on the adaptation of some tomato varieties under saline condition. M.Sc. Thesis, Agriculture Ain Shams University

Karikari, A.Y. and J.A. Ampofo, 2006. Assessment of African Lake Water Quality for Recreation Purposes. CSIR, Accra Ghana, Africa.

Malash, N., T.J. Flowers and R. Ragab, 2005. Effect of irrigatin systems and water management practices using saline and non-saline water on tomato production. Agric. Water. Manage., 78: 25-38.

Qasem, J.M. and O.M. Judah, 1985. Tomato yield and consumption use under different quality water and using plastic mulch. Dirasat, 12: 23-33.

Rhoades, J.D., A. Kandiah and A.M. Mashali, 1992. The use of saline waters for crop production. FAO Irrigation and Drainage Paper No. 48. FAO, Rome.

Shalhevert, J., 1994. Using water of marginal quality for crop production: Major issues. Agric. Water Manage., 25: 233-269.

Silva, W.L.C. and W.A. Maroucelli, 1996. Evaluation of irrigation scheduling techniques for processing tomatoes in Brazil. Proceedings of the International Conference on Evapotranspiration and Irrigation Scheduling, (ICEIS'96), St. Joseph, MI: ASAE, pp: 522-526.

Wan, S., Y. Kang, D. Wang, S.P. Liu and L.P. Feng, 2007. Effect of drip irrigation with saline water on tomato (*Lycopersicon esculentum*) yield and water use in semi-humid area. Agric. Water Manage., 90: 63-74.

Yurtseven, E., G.D. Kesmez and A. Unlukara, 2005. The effects of water salinity and potassium levels on yield, fruit quality and water consumption of a native central Anatolian tomato species (*Lycopersicon esculantum*). Agric. Water. Manage., 78: 128-135.