MEDWELL PUBLISHING
Research Journal of Biological Sciences 4 (5): 632-636, 2009
ISSN: 1815-8846

The Effect of Irrigation Regimes on Yield and Chemical Quality of Oriental Tobacco in West Azerbaijan

Hojat Salehzade, Amir Fayyaz Mogaddam, Iraj Bernosi, Mehdi Ghiyasi and Parviz Amini
Department of Agronomy and Plant Breeding, Faculty of Agriculture,
Urmia University, Urmia, Iran

Abstract: In order to investigate different irrigation regimes effect on quality and quantity of oriental tobacco, an experiment has been conducted with split plot design as a RCB with four replications in Tobacco research center of Urmia during 2006 growing season. A main plots and subplots were allocated to 3 oriental tobacco varieties (Bassma serres 31, Izmir and Zichna) and three levels of irrigation regimes (irrigation after available soil water depletion reached to 60, 80 and 100% ranges), respectively. The means comparison showed that dry leaf yield, usable yield, sugar, potassium and chlorine levels in leaves were maximum in plots that were irrigated after 60 and 80% depletion of available soil water. There were no different between these 2 treatments. Leaf nicotine level was maximum in plots that were irrigated after 100% depletion of soil available water. The results showed that quantities and qualities characteristics of tobacco were the best in plots that were irrigated after 80% depletion of soil available water. The quantities and qualities characteristics of Bassma serres 31 and Zichna tobacco varieties were better than those of Izmir tobacco variety.

Key words: Oriental tobacco, irrigation, soil available water depletion, quality, yield, West Nigeria

INTRODUCTION

Irrigation is an important component for the production of tobacco in Urmia, Iran. Tobacco is generally considered a drought tolerance plant and sensitive to excessive water (Layton and Nielsen, 1999). Therefore, it is important to apply the water at proper time and in appropriate amount for optimum crop response and maximum economic benefit to the grower. Over irrigation causes damage to the root system and leaching essential nutrients below the root zone resulting in poor yield and poor quality of cured leaf (Moor and Tayson, 1998; Sifola *et al*., 1998).

It has been known that frequency of irrigation and amount of used water are associated not only with the quantity but with quality and chemical compound of tobacco leaves (Assimi, 2004). Therefore, in production of tobacco quality and chemical compound of cured leaf are as important as yield that is why special attention should be given to right irrigation time and right amount of water chemical coppounds effect taste and flavor of tobacco.

For example high sugar and low nicotine level results in smooth tastes of tobacco (Nagarajan and Prasa DRao, 2004), increased a mount of potassium and decreased Cl lead to good burning quality (Peeding, 1999; Sifola *et al*., 1998).

Good burning quality in itself fully inciate taste and flavor potential of tobacco. Sifola *et al.* (1998) reported tobacco produced in water rich field in comparison to dry field contained high amount carbohydrate and less alkaloids. Fusheng (2005) found increased irrigation causes increased potassium absorption resulting brtter quality cured leaf. In general with regard to quality, morphology and even echomorphological traits there are many differences between flue-cured and oriental tobacco (Wolf, 1962). One important happens between 2 types is their need to irrigation. Oriental tobacco usually needs less water thus proper reduction in frequency and amount of irrigation water lead to increase of quality. It may be for this reason, in Turkey and Greece when oriental tobacco encounter with drought or lower rainfall during of summer, the aroma and flavor of tobacco are improved (Wolf, 1962).

So, if we could find a right irrigation regime to oriental tobacco, we can save in irrigation casts and mean, while increase the quality of our production.

It is obvious that draomatic reduction in irrigation water damage the plant and causes ample qualitative and qualitative loss. In order to find out the best irrigation regime, which provide optimum yield and quality balanced in oriental tobacco this research conducted in Urmia tobacco research center.

Corresponding Author: Mehdi Ghiyasi, Department of Agronomy and Plant Breeding, Faculty of Agriculture, Urmia University, Urmia, Iran

MATERIALS AND METHODS

Field experiment was conducted in Tobacco Research Center of Urmia (37°40'N; 45°2.2'E) in West Azerbaijan, Iran in 2006. A profile with 150 cm depth was excavated before transplanting. Soil texture (Hydrometer method), bulk density (paraffin method), the soil moisture in field capacity and permanent wilting point were measured in of horizons. The each soil texture was clay silty loam. Bulk density in average was 1.36 g cm^{-3} in the depth of root zone. The soil volume water in field capacity and permanent wilting point were 32 and 19 percentages, respectively.

In order to investigation of irrigation regimes on three oriental tobacco (variety B.S. 31, Izmir, Zichna), an experiment was conducted with a split plot design and four replication in Tobacco Research Center of Urmia for growing season in 2006. A main plots and subplots were allocated to three oriental tobacco varieties (Basma serres 31, Izmir 7 and Zichna) and three levels of irrigation regimes (irrigation after available soil water depletion reached to 60, 80 and 100% ranges), respectively.

The soil moisture content was determined by soil sampling and when the soil moisture was reached to specific levels in different treatments, the irrigation was started immediately. Experiment field was transplanted in the early parts of July. Spacing between rows and plants on raw was 60 and 3 cm, respectively. Irrigation depth in 3 levels irrigation regimes based on 60, 80 and 100% depletion of soil available water was 42, 56 and 70 mm, respectively (Eq. 1-3).

$$AW = \theta_{(F.C)} \times \theta_{(P.W.P)} \quad (1)$$

$$d = 10 \times AW \times D \quad (2)$$

$$I = d \times MAD \quad (3)$$

In which:

AW = The available volume soil water portion

$\theta_{(F.C)}$ and

$\theta_{(P.W.P)}$ = The volume soil water portion of soil in field capacity and permanent wilting point

d = The depth of water in the depth of root zone (cm) that the depth of root zone was 50 cm in this experiment

I = The depth of irrigation water (mm) (Alizadeh, 1999)

The volume of irrigation water in transplanting time and rooting phase was measured by parshal flume. The soil moisture content was determined with soil sampling after end of rooting phase to end of harvest stage every evening. Irrigation was used when soil volume moisture content was 24, 21 and 19 percentages in 0.6, 0.8 and 1 of MAD, respectively. We had any rainfall in growing season.

Plant leaves was harvested in 4 times. Green leaf yield, dry leaf yield, usable dry leaf yield was measured after harvesting. The samples of dry leaf from second leaf cutting were sent to chemical laboratory to measure nicotine, sugar, potassium and chlorine in leaf. Statistical analysis of data was achieved by MSTATC.

RESULTS

Morphological traits: Results showed irrigation regime had significant effect on evaluated morphological traits such as plant height, stem diameter, leaf length, leaf width, dry leaf yield and usable yield ($p<0.01$). Also, studied varieties had significant difference in leaf length (Table 1). The interaction of irrigation regime and variety in respect to leaf length, dry leaf yield and usable leaf yield was significant (Table 2).

Chemical traits: The results showed that irrigation regime had significant effect on sugar, nicotine, potassium and chlorine percentage ($p<0.01$). In addition except for potassium other traits in all varieties had significant difference (Fig. 1 and 2). Also, the interaction of irrigation regime and variety was significant for sugar and potassium percentage at ($p<0.05$) (Fig. 3).

Table 1: The effect of irrigation regimes on plant height, stem diameter and leaf width of oriental tobacco

Irrigation regime	Plant height	Stem diameter	Leaf width
I_1	106.50a	12.43a	12.24a
I_2	107.50a	12.25a	12.25a
I_3	92.17b	11.00b	10.77b

Table 2: Evaluation of usable yield leaf length, dry leaf yield and usable yield of three variety of oriental tobacco under different irrigation regimes

		Traits		
Variety	Irrigation regime	Leaf length	Dry leaf yield	Usable yeild
B.S. 31	I_1	45.25b	2160a	1645c
	I_2	27.25b	2138a	1728abc
	I_3	35.23c	1537d	1311d
Izmir	I_1	9.26b	2171a	1829a
	I_2	9.25b	1942c	1326bc
	I_3	9.20d	1549d	1677d
Zichna	I_1	05.29a	2213ab	1777ab
	I_2	55.28a	2177ab	1793a
	I_3	7.25b	1677d	1430d

Different letters within columns indicate least significant difference at $p<0.1$; I_{1-3}, Irrigation after available soil water depletion reached to 60, 80 and 100% range, respectively

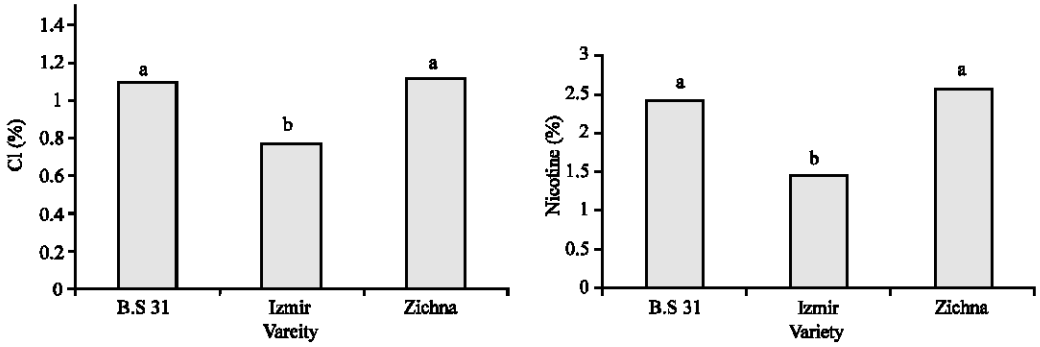

Fig. 1: Comparison of percentage of chlorine and nicotine in different variety of oriental tobacco. The same letters indicate not significantly at $p<0.01$

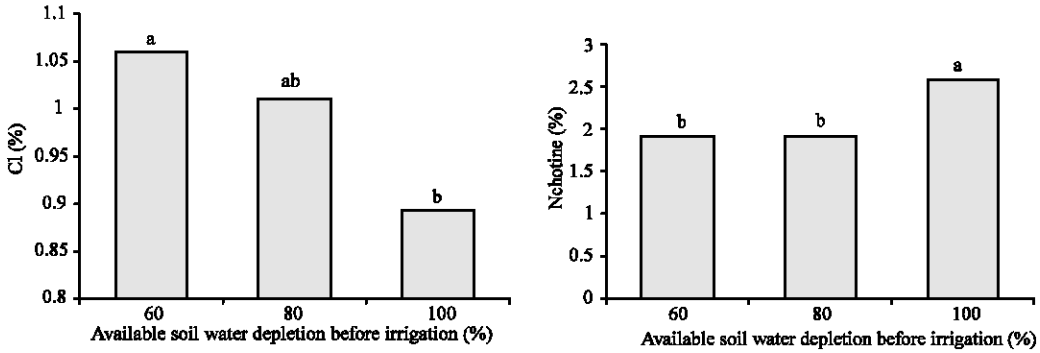

Fig. 2: The effect of irrigation regimes on Chlorine and nicotine tobacco leaf. The same letters indicate not significantly at $p<0.01$

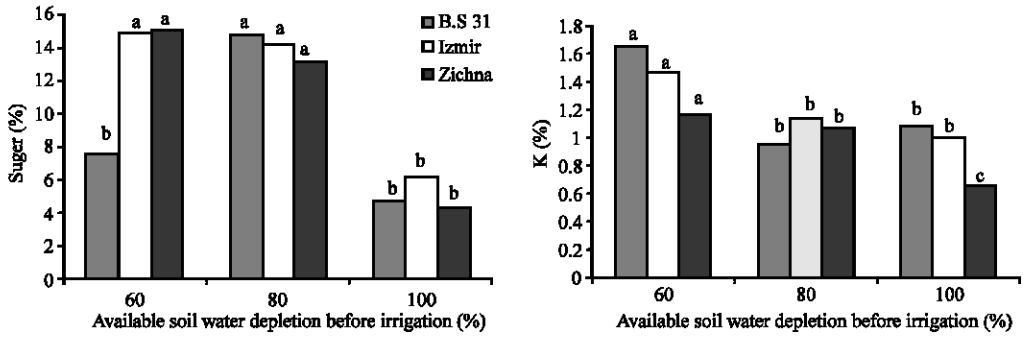

Fig. 3: Sugar and potassium percentage of several variety of oriental tobacco under different irrigation regimes

DISCUSSION

Irrigation regime had dramatic effect on all concerning quality and morphological traits. With increase of water amount, irrigation after 60 and 80 available soil water depletion, yield and all morphological traits were improved. This happens because of a reason that all vital and metabolic activities of plant depend on availability of water. Any kind of water stress first reduce tissues pressure potential, which lead to reduced water potential in meristem tissues then this lead to plasmolize, reduction of cell expansion and cell wall division, which all causes decreased protein and wall cell synthesis (Hopkinson, 2005; Doorenbos and Kassan, 1986). All factors results in togur deficiency, which leads to decrease of photosynthesis thus causing smaller leaf and stem development. Sifola and Postiglione (2003), Mcnee *et al.* (1978) and Maw *et al.* (1997) were reported the same results.

Availability of water also has significant effect on qualitative traits of tobacco. With increase of water stress, irrigation in 100% soil water depletion, the tobacco leaf nicotine percentage was increased.

Percentage of Nicotine is one of the most important traits. When tobacco grows in field with abundant waters percentage of nicotine decreases in leaf (Sifola and Postiglione, 2002), which is a desired trait. Balance of nicotine and carbohydrate synthesis depends on activity of an enzyme called nitrate reductase (Weybrew *et al*, 1983). In highly irrigated, N is leached and its absorption by tobacco will be decreased. Therefore, lack of N inhabits and activity of this enzyme (*Nitrate reductase*) leading to production of more carbohydrates and less nicotine in leaf (Reynolds and Rosa, 1995). Synthesis of nicotine takes place in root areas of tobacco when the water is not available enough, root system deepens and expand in soil causing more nicotine synthesis.

In the lowest irrigation regime, irrigation in 100% soil water depletion, the percentage of sugar was decreased (Fig. 3). A way that plant can resist drought is to decrease its osmotic pressure in order to increase its pressure plant have to dissolve some of its polymers. This process turgids cell causing higher pressure potential to cope with lack of water. In drought stress hydrolyzing enzymes such as amylase increases. Amylase then dissolve starch, which is the main ingredient of tobacco leaf, to reducing sugar leaving less amount of starch in leaf (Layton and Nielsen, 1999). Our results confirm the findigs of Sifola *et al*. (1998) and Philips *et al*. (1991), who reported that tobacco produced in water rich field in comparison to dry field contained high amount of carbohydrate and less alkaloids

Another desired trait which is economically important in marketing in the tobacco is good burning quality. This treat is positively related to amount of potassium in leaf which means more of potassium helps good burning. Increased irrigation ends up in increased amount of potassium (Fig. 3). This can be explained by the fact that the decrease of soil water reduces the diffusion rate of potassium and its uptaking by root (Fusheng, 2005).

CONCLUSION

Nahar and Gretzmacher (2002) reported that increasing of irrigation mount lead to high potassium absorption that was according to our results. After all generally, we can conclude that in all studied variety proper irrigation, avoiding excessive water, results in better yield and quality. Study showed the best results achieved with Bassma serres 31 and Zichna, which can be recommended with regard to natural condition of the region. Irrigation after 80% depletion of available soil water because of highest quality and quantity traits was recommended in this study. Irrigation after 60% depletion of available soil water had no difference with irrigation after 80% depletion of available soil water except on more irrigation time.

REFERENCES

Alizadeh, A., 1999. Water, soil and plant. Astan Gods Razavi, Imam Reza University, Iran.

Assimi, M.H., 2004. Effect of irrigation management on tobacco yield in comparison with dry land farming. Abstracts of presentations made at the 2004 CORESTA Congress, Kyoto, Japan.

Doorenbos, J. and A.H. Kassan, 1986. Yield response to water, FAO Irrigation and Drainage, FAO, Rome, pp: 33.

Fusheng, L., 2005. Potassium and water interaction. International workshop on soil potassium and fertilizer. Agricultural College Guangxi University. Naning Guangxi 530005.

Hopkinson, J.M., 2005. Effects of drought and transplanting on the subsequent development of the tobacco plant. Aust. J. Agric. Res., 19 (1): 47-57.

Layton, D. and M.T. Nielsen, 1999. Tobacco production. Chemistry and Technology, pp: 470.

Maw, B.W., J.R. Stansell and B.G. Stansell, 1997. Soil-plant-water relationships for flue-cured tobacco. The Georgia agricultural extention, college of agriculture and environmental science. The university of Georgia. Research Bulletin, No: 427.

Mcnee, P., L.A. Warrell and E.D. Muyzenberg, 1978. Influence of water stress on yield and quality of flue-cured tobacco. Aust. J. Exp. Agric. Anim. Husbandry, 18: 726-731.

Moor, J.M. and A.W. Tyson, 1998. Irrigating to tobacco. The University of Georgia, College of Agricultural and Environmental Sciences Cooperative Extension Service.

Nagarajan, K. and J.A.V. Prasa DRao, 2004. Textbook of field crops production, published by directorate of information and publication of agriculture Indian Council of Agricultural Research Krishi Anusandhan Bhavan, Pusa, New Delhi 110012, pp: 769-812.

Nahar, K. and R. Gretzmacher, 2002. Effect of water stress on nutrial uptake, yield and quality of tomato under subtropical condition. Die Bodenkultur, 53 (1): 43.

Peeding, G.F., 1999. Production Practice: Flue-cured Tobacco. In: Dvis, L.D. and M.T. Nielsen, Tobacco: Production, Chemistry and Technology. Blackweel Science, University Press Cambridge, UK, pp: 104-142.

Philips, R.E., J.E. Leggest, J.F. Chapline and J.M. Zelezink, 1991. Effect of water stress on growth assimilation and partitioning of carbon and nitrogen in barley tobacco. Tob. Sci., 35: 22-27.

Reynolds, L.B. and N. Rosa, 1995. Effect of irrigation scheduling and amounts on flue-cured tobacco in Ontario. Tob. Sci., 39: 83-91.

Sifola, M.I. and L. Postiglione, 2003. The effect of nitrogen fertilization on nitrogen use efficiency of irrigated and non-irrigated tobacco (*Nicotiana tabacum* L.). Plant Soil, 252: 313-323.

Sifola, M.I., B. Cuolcoo and L. Postiglione, 1998. Effect of increasing nitrogen fertilization rate on yield and quality of Burley tobacco grown under stressed and well-watered condition. Italy J. Agron., 2: 117-125.

Sifola, M.I. and L. Postiglione, 2002. The effect of NaCl in irrigation water on growth, gas exchange and yield of tobacco Burley type. Field Crops Res., 47: 81-91.

Wolf, F.A., 1962. Aromatic or oriental tobacco. Durham, N. Carolina, Duke U.P., pp: 278.

Weybrew, J.A., W.A. Wan Ismail and R.C. Long, 1983. The cultural management of flue-cuer tobacco quality. Tob. Sci., 27: 56-61.