تعیین حداکثر ضریب تخلیه مجاز رطوبت خاک در مراحل مختلف دوره رشد توتون، واریته باسماسرس۳۱

DETERMINATION OF MAXIMUM ALLOWABLE DEPLETION FRACTION OF AVAILABLE SOIL WATER IN DIFFERENT STAGES OF GROWTH FOR ORIENTAL TOBACCO, VARIETY BASMA SERRES 31.

R. Ranjbar and R. Taghavi
(Tobacco Research Center of Urmia)

Abstract:

Irrigation is an important component for the production of quality tobacco under the semiarid climatic and unreliable rainfall condition of the West Azerbaijan, Iran. The portion of available soil water that is easily absorbed by plant and usually leads to maximum yield is defined as "Maximum Allowable Depletion" fraction and is shown as MAD. This is an important parameter for determination the irrigation depth and frequency in irrigation scheduling. In order to determine MAD in two growth stages of oriental tobacco (Variety Basma Serres 31), an experiment was conducted with a split plot design and four replication in Tobacco Research Center of Urmia for two growing season (2004 and 2005). The main plots and subplots allocated to two level of MAD fraction in the harvest stage (B1=0.6 and B2=0.8) and three level of MAD fraction in the rapid stage (A1=0.4, A2=0.6 and A3=0.8), respectively. The soil moisture content was determined with gypsum blokes. When the soil moisture was reached to specific levels in various treatments, the irrigation was used started immediately.

The results showed that MAD levels in rapid growth stage had significant effects on usable dry leaf yield, gross income of farming and the price of one unit weight of usable dry leaf that usable dry leaf yield was maximum in A1. Also, these levels of MAD had significant effects on leaf quality and gross income of tobacco farming that was maximum in A2, mainly because of high quality. In harvest stage, MAD levels had significant effect on total, usable dry leaf yield and water use efficiency that were maximum in B1, but the quality of dry leaf in B1 was lower than that in B2. Heavy applications tended to affect quality adversely. The effect of year was significant on the price of unit weight of usable dry leaf and usable dry leaf yield. In spite of maximum usable dry leaf yield in A1, gross income of farming decreased because of the least quality of cured leaf and the price of unit weight of usable dry leaf in A1 level in comparison with A2. MAD fraction for rapid growth and harvest stages determine 0.6 and 0.8, respectively. Crop water requirement content was measured 435 mm. Irrigation frequency for rapid growth and harvest stage was measured on the average 8 and 12 days, respectively.

Key words: Tobacco – Irrigation – Soil available water – Water use efficiency.

1- Corresponding author. Tel. : +98- 441-2620907; Fax: +98-2620909, e-mail: ranjbarrahim@yahoo.com

1- Introduction

Irrigation is an important component for the production of tobacco in Urmia, Iran. It is important to apply the water at proper time and in the appropriate amounts for optimum crop response and maximum economic benefit to the grower (Moor and Tyson, 1998). Tobacco is generally considered a drought tolerant plant. But, irrigation should be used on time and in amounts to bring the soil moisture level up to or close to field capacity under inadequate soil moisture condition. Contrary, over-application of irrigation should be avoided because of the possibility of negatively affecting yield and quality of the cured leaf by causing damage to the root system or leaching needed nutrients below the root zone and out of reach of the roots quality (Moor and Tyson, 1998). Asimi (2002) showed that the plants in irrigated treatments had more vigorous growth than those of non-irrigated control. Also, Assimi (2004) under the humid climatic conditions of the Gillan province showed that irrigation treatments in comparison with non-irrigated control was significant in fresh leaf, dry leaf yield, price of unit weight and net income of tobacco farming. Tobacco Leaf quality can be significantly affected by irrigation at to stages of growth and development, the rapid growth phase and harvest. During the rapid growth, soil moisture extremely is important to tobacco plant as it is needed to insure good leaf expansion and improve yield and quality (Moor and Tyson, 1998). Physiological changes within the plant result in reduced transpiration loss of moisture from the plant during harvest stage (Reed and *et all,* 1994). Therefore, it is important to plan different irrigation scheduling for these growth stages. Various methods and techniques such as the rate of soil available water depletion, plant canopy temperature, water potential in leaf, soil water suction, the rate of associative evaporation from flat, and soil moisture sensing devices are used for irrigation scheduling with regard to the feasibility and accuracy. Among these techniques, applying the amount of available soil water depletion is important, creditable, and reliable that was used in this experiment. In this method, soil moisture has been measured several times in the depth of root zone for growth stages. Applying the amount of available soil water depletion method is very time-consuming in practice. Measurements in other methods are simple and are not time-consuming and involves determine of ranges for each applied parameters that depend on plant type and environment condition. The each of these methods should be compared with first method as a reference (Asgarzadeh, 2003). The maximum allowable depletion of soil available water (MAD) is the portion of maximum level of available soil water that is determined with regard to the acquisition maximum crop yield and quality in field condition. This is an important parameter for determining the irrigation depth and frequency in irrigation scheduling that generally is more creditable than other parameter (such as associative evaporation from flat and leaf temperature) in irrigation scheduling. The range of MAD depends on irrigation management, plant growth stage, plant type, soil texture, and potential evapotranspiration (Jarollahi, 2001). Razavi and Fajri (1995) determine irrigation frequency 15 days and water requirement 3400 m^3/ha for tobacco (Var. Basma Serres 31) with evaporation flat (A class) in Tobacco Research Center of Ormia. Also these authors indicated that water requirement for tobacco (Var. Basma Serres 31) was 3680 m^3/ha by lysmeter.

2- Materials and Methods

Field experiment was conducted in Tobacco Research Center of Urmia (37^0 40` N; $45^0$ 2.2` E) in West Azarbayjan, Iran over two years (2004-2005). A profile with 150 centimeters 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 the each of horizons. The soil texture was clay silty loam. Bulk density in average was 1.36 gr/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 determine MAD in two growth stages of oriental tobacco (variety B.S.31), an experiment was conducted with a split plot design and four replication in Tobacco Research Center of Urmia for two growing season (2004 and 2005). The main plots and subplots allocated to three level of MAD fraction in the rapid stage (A1=0.4, A2=0.6 and A3=0.8) and two level of MAD fraction in the harvest stage (B1=0.6 and B2=0.8), respectively. The soil moisture content was determined from starting rapid growth stage with gypsum blokes, which had been buried in soil at 25 centimeters depth. 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 row was 60 and 30 centimeters, respectively. Irrigation depth in three levels of MAD fraction, 0.4, 0.6, and 0.8 was 28, 42, and 56 mm, respectively (equation 1, 2, and 3).

1) $AW= \theta_{(F.C)} * \theta_{(P.W.P)}$
2) $d=10 * AW * D$
3) $I=d * MAD$

In which AW is the available volume soil water portion, $\theta_{(F.C)}$ and $\theta_{(P.W.P)}$ are the volume soil water portion of soil in field capacity and permanent wilting point, d is the depth of water in the depth of root zone (cm) that the depth of root zone was 50 cm in this experiment, I is the depth of irrigation water (mm). The volume of irrigation water in transplanting time and rooting phase was measured by parshal flume. The soil moisture content was determined with gypsum blokes from starting rapid growth stage to end of harvest stage which had been buried in soil as 25 centimeters. Irrigation was used when soil volume moisture content was 27, 24, and 21 percentages in 0.4, 0.6, and 0.8 of MAD, respectively.

Plant leaves was harvested in four times. Green leaf yield, dry leaf yield, usable dry leaf yield was measured after harvesting. Gross income of farming and the price of one kilogram of usable dry leaf were calculated after evaluation. The samples of dry leaf from second leaf cutting were sent to chemical laboratory to measure nicotine, sugar, ash, and chlorine in leaf. Statistical analysis of data was achieved by MSTATC.

Results

Irrigation scheduling in two stages of plant growth was various that illustrated in table 1. The levels of MAD in rapid growth, A1, A2, and A3 were irrigated 5, 4, and 3 times, respectively.

Table 1- Irrigation scheduling

MAD level		The no. irrigation		applied water (m3/ha)	W.U.E*	Average Irri. Frequancy(day)	
Rapid growth	Harvest	Rapid growth	Harves t			August	September
A1	B1	5	4	4760	0.39	5	8
	B2	5	3	4650	0.35	5	12
A2	B1	4	4	4450	0.45	8	8
	B2	4	3	4350	0.36	8	12
A3	B1	3	4	4280	0.41	11	8
	B2	3	3	4000	0.38	11	12

* - W.U.E is Water use efficiency

The results showed that MAD levels in rapid growth stage had significant effects on usable dry leaf yield, gross income of farming and the price of one unit weight of usable dry leaf that usable dry leaf yield was maximum in A1. Also, these levels of MAD in rapid growth stage had significant effects on leaf quality and gross income of tobacco farming that was maximum in A2, mainly because of high quality. In harvest stage, MAD levels had significant effect on total, usable dry leaf yield and water use efficiency that were maximum in B1, but the quality of dry leaf in B1 was lower than that in B2. Heavy applications tended to affect quality adversely. Interaction effects between A and B factors were not significant. The effect of year was significant on the price of unit weight of usable dry leaf and usable dry leaf yield that in 2004 was more than that in 2005. Leaf chemical composition of tobacco leaves were not affected by MAD levels. The results of means comparison in table (2) indicated that the usable dry leaf yield was maximum in A1 level, the price of unit weight of usable dry leaf and gross income of farming was maximum in A2 level of MAD. In spite of maximum usable dry leaf yield in A1, gross income of farming decreased because of the least quality of cured leaf and the price of unit weight of usable dry leaf in A1 level in comparison with A2. Gross income of farming decreased in A3 level because of the least dry leaf yield and usable dry leaf yield. The results indicated that the irrigation scheduling in rapid growth stage is very important. Means comparison of the MAD levels in the harvest stage indicated that the water use efficiency, usable dry leaf yield and dry leaf yield was maximum in B1.

MAD levels in the rapid growth stage		
Gross income of farming (Rails/ha)	**The pries of one kilogram of dry leaf (Rails/Kg of tobacco)**	**Usable leaf yield (Kg/ha)**
10993000 **b**	7060 **b**	1593 **a**
12173000 **a**	7800 **a**	1567 **ab**
10667000 **b**	7300 **b**	1468 **b**
MAD levels in the harvest stage		
Usable dry leaf yield (Kg/ha)	**Water use efficiency (Kg of tobacco/m3 of water)**	**Dry leaf yield (Kg/ha)**
1664 **a**	0.42 **a**	1870 **a**
1421 **b**	0.36 **b**	1580 **b**

Table 2- Comparison of quantity and quality characteristics of tobacco in various MAD levels.

Among MAD levels in the rapid growth stage, the A1 level because of the least quality and A3 level because of the least yield and gross income of farming was rejected. Among MAD levels in the harvest stage, the B1 level because of the least quality was rejected. Thus, MAD fraction for rapid growth and harvest stages determine 0.6 and 0.8, respectively. Crop water requirement content in plan growth period was measured 435 mm. Irrigation frequency for rapid growth and harvest stage was measured 8 and 12 days in average, respectively.

References

1- ***Asgarzadeh, H.*** 2003. Determination of soil water suction, evaporation from flat, plant canopy temperature, and leaf water potential ranges for irrigating of wheat (Alvand variety) in Karkaj. Agricultural Faculty, Tabriz University, Iran.

2- ***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.

3- ***Assimi, M.H.*** 2002. Determining the water application rate in supplementary tobacco irrigation. Abstracts of presentations made at the 2002 CORESTA congress, New Orlaens, U.S.A.

4- ***Reed, D., D. Gooden, and D. Smith.*** 1998. Tobacco irrigation. AG -519 -8, North Carolina Cooperative Extension Service, North Carolina State University.

5- ***Razavi, R., and H. Fajri***. 1995. Determination of water requirement for Oriental Tobacco (Variety B.S.31) by evaporation flat (A class). Research Report Book. Tobacco Research Center of Urmia. Iranian Tobacco Company.

6- ***Moor, J.M., and A.W. Tyson.*** 1998. Irrigating Tobacco. The University of Georgia, College of Agricultural & Environmental Sciences Cooperative Extension Service.

http://www.griffin.peachnet.edu/caes/tobacco/handbook/irrigating98.html