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Effect of Irrigation Rates under Irrigation System on Yield, Quality and Water Use Efficiency in Thompson Seedless Grapes Raised on Dogridge Rootstock

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Introduction

Grape is a commercially important fruit crop in India, mostly grown in semi arid dry area with limited water availability. Water is a main factor, limiting teh quality and yield in arid zones (Fanizza and Riccardi, 1990). Due to several restrictions on availability of good quality water for irrigation and uncertasinty of rains, rootstocks could provide an attractive and environmentally sound alternative to these twin problem (Prakash, 1998). Hence, use of drought resistant cultivars or rootstocks have special significance in grape cultivation (Chadha, 1984). A properly managed irrigation programme not only improves yield but also improves water use efficiency. Evapotranspiration (ET) rate of vine is an effective guide for irrigating the vineyards (Peacock *et al.*, 1987). Due to twin problems of irrigation water shortage and salinity, growers have adopted drip irrigation but water requirement for irrigation in Thompson seedless grapes raised on Dogridge rootstock is not available. Tehrefore, the present study has been undertaken to determine the optimum irrigaiton rates using the pan evaporation data as a basis for scheduling irrigation and to compare the efficiency of irrigation water in drip irrigation system for Thompson seedless grapes raised on Dogridge - Bangalore rootstock.

Material and Methods

A field experiment was conducted at National Research Centre for Grapes, Research farm at Pune (Maharashtra) during the year 2000-2002 on the Thompson seedless grapes raised on Dogridge rootstock at a spacing of 10'x6'. The soil was black cotton (vertisols) with pH 8.5, EC 0.50, organic carbon 0.90, available P 10 ppm and available K 125 ppm. The field capacity, permanent wilting point and bulk density were 36%, 18% and 1.20 gm/cc, respectively. The climate of this is region semi arid. During the study period, total rainfall was recorded was 565 mm in 2001 and 470 mm in 2002. The vines were grafted on Dogridge-Bangalore in October 1998 and framework of the vine was developed uniformly till April 2000. The vines were pruned in April and October during the year.

Three treatments were tested under drip irrigation system, consisting of 80% (T1), 60% (T2) and 40% (T3) % of replenishment rate of pan evaporation under randomized block design with seven replications. Each replication had five vines as a unit for recording the observation on vine growth, yield and qality parameters. The vines were fertilized with N, P_2O_5, and K_2O of 660, 880 and 660 kg/ha/year through Urea, Single super phosphate and Sulphate of potash. Fifty percent of N, 60% of P and 40% of K were applied during April to August, while the rest of the nutrients were applied during October to February. Initially, all the treatments received a common irrigaiton to bring the soil moisture to field capacity and thereafter vines were irrigated as per treatment. The quantity of water was applied 946, 710 and 473 mm during the crop period under 80, 60 and 40% of replenishment rates of pan evaporation, respectively.

The irrigation treatments were imposed as per daily pan evaporation (pan factor 0.7). The amount of rainfall received was deducted from the evaporation. lateral liens with valves were laid out for drip irrigation. Three drippers were placed per vine in lateral. The rate of discharge from each dripper was 4 litres per hour at a pressure of 1 bar. The effective rainfall in drip irrigation was

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estimated as the daily rainfall equal to or less than daily evaporation. Weight of 50 berries, total soluble solids content and acidity were determiend from 50 berries colleted randomly from each irrigation treatment. Water use efficiency was calculated by dividing the fruit yield with total applied quantity of water. Brix yield was workout by multiplying the fresh yield with total soluble solids (TSS) and dividing with hundred.

Results and discussion

The data on yield attributes, quality and water use efficiency are given in Table 1. Highest yield was recorded in treatment T_1 which was statistically at par with treatment T_2. Treatment T_3 resulted in significantly lower than treatment T_1 and T_2. Treatment T_3 were irrigated at 40% replenishment rate of pan evaporation (PE) throughout the season. Increased bunch weight and yield was recorded in vines receiving adequate irrigation water as compared to those grown under deficient soil moisture conditions (Satyanarayana, 1982). Fimbres and Lagarda (1985) found that most critical times for water application were during the formation of fruiting canes (41-60 days after bud sprouting) and during fruit development (61-126 days after bud sprouting). Nijjar and Sharma (1973) observed higher yields of vines with irrigation at 50 centibar as compared to irrigation at 100 centibars. McCarthy (1997) reported that the soil moisture stress reduced the yield and yield contributing parameters significantly. The vine yield reduced significantly in unirrigated vines compared to irrigated ones. Similar trend was also observed for mean bunch weight and hundred berry weight. Mathews and Anderson (1989) reported that the water deficit after flowering resulted int eh greatest reduction in berry weight and yield when compared to well irrigated vines. Maximum bunch weight was recorded under Treatment T_1, which was not influenced significantly by the treatments.

Number of bunches per vine was highest under treatment T_1 which was statistically at par with treatment T_2. Statistically less numebr of bunches per vine was recorded in treatment T_3. Maximum 50 berries weight was recorded udner treatment T_1, which was significantly higher than rest of the treatments. Lower 50 berries weight was recorded in treatment T_3. Mathews and Anderson (1989) reported that the water deficit after flowering resulted in the greatest reduction in berry weight and yield when compared to well watered vines. However, the treatments subjected to stress during 110-140 days after winter pruning reduced the berry size and hastened the ripening (Shikhamany *et al.*, 1993). Brix yield is considered as better indicator of vine performance. Highest brix yield (Yield x TSS/100) was recorded in treatment T_1, which was statistically at par with treatment T2. Treatment T_3 resulted in significantly lower than treatment T_1 and T_2. Brix yield was significantly higher in irrigated vines compared to unirrigated (Ramteke *et al.*, 1999).

Highest TSS content was recorded in treatment T_3, which was statistically at par with treatment T_2. Treatment T_1 resulted in significantly lower

Table 1. Effect of irrigation rate on yield, quality and water use efficiency in Thompson Seedless grapes raised on Dogridge Rootstock (Average data of 2 years)

Treatment	Yield (t/ha)	Brix yield (t/ha)	Av. Bunch Wt. (gm/vine)	Av. Bunch (No./vine)	TSS (°B)	Acidity (%)	50 berry Wt. (gm)	Biomass April (gm)	Biomass October (gm)	WUE Brix yield (kg/ha-mm)
T1	16.82	3.91	218	43	23.23	0.58	107.8	647	2173	4.09
T2	16.51	3.88	225	41	23.60	0.57	99.60	644	1822	5.43
T3	11.81	2.79	205	32	23.65	0.56	88.20	514	1595	5.67
SEM	0.98	0.23	12.75	1.62	0.15	0.009	2.04	38.97	110	0.32
CD (0.05)	2.13	0.50	NS	3.53	0.33	NS	4.45	84.0	240	0.69

than treatment T_2 and T_3. Prolonged stress from veraison stage onwards increased the total soluble solids (Nijjar and Chopra, 1972; Christensen, 1975). Highest acidity in grape juice was recorded in treatment T_1 but did not vary significantly with rest of treatments. Higher acidity was observed with more water application (Madhava Rao *et al.*, 1975). Nijjar and Sharma (1973) observed that irrigations during berry ripening reduced the TSS content and increased acidity. The acidity was higher in irrigated vines and although increase in total soluble solids was found under stress, it did not differ significantly with irrigated treatment (Ramteke, *et al.*, 1999).

Highest pruning weight was recorded in both April and October under treatment T_1, which were statistically at par with treatment T_2. Significantly lwoest pruning weight was recorded in treatment T_3. It indicated that irrigation increased weight of pruned material (Kalia, 1970 and Patil 1977). Evaporation replenishment with 100% recorded higher pruning weight compared with the 7.5 and 50% treatments (Srinivas *et al.*, 1999).

Highest water use efficiency was observed in treatment T_3, which was statistically at par with treatment T_2. The lowest water use efficiencywas observed in treatment T_1. Water use efficiency increased with increase in evaporaiton replenishment rates. The water use efficiency was higher with 50 % evaporation replenishment as compared to 75 and 100% evaporation replenishment (Srinivas *et al.*, 1999).

Conclusion

Based on experimental results, it may be concluded that 60% replenishment rate of pan evaporation is the best irrigation level for Thompson seedless grapes raised on Dogridge rootstock in respect of yield, brix yield, quality and water use efficiency.

References

Chadha, K.L. 1984. Grape research in India-priorities and suggestions approach for future. *Indian J. Hort.* **41** (3&4) : 145-159.

Christensen, P. 1975. Response of Thompson seedless grapes vines to the timing of pre-harvest irrigaiton cutoff. *Amer. J. Enol. vitic.* **26** : 188-194.

Fanizza, G. and I. Riccardi 1990. Infleunce of drought stress on shoot, leaf growth, leaf water potential, stomatal resistance in vine grape genotypes (*vitis vinifera*). *Vitis* Special Issue : 371-381.

Fimbres, F.A. and Lagarda, M.R. 1985. Optimization of drip irrigation system in grapevine (*Vitis vinifera*) in Caborcarigion. *Agricultura-Tecnica - en-Mexico.* **11**(1) : 51-67.

Kalia, M. 1970. Effect of different soil moisture regimes on yield and quality of Anab - e-shahi grape (*vitis vinifera* L) M.Sc. thesis, Punjab Agricultrual University, Ludhiana.

Madhava Rao, V.N., Sivanappan, R.K., Palaniswamy, K.P. and natarajan, P. 1975. A preliminary note on water requirement of grapes. *South Indian Hort.* **23** (1-2) : 54-55.

Mathews, M.A. and Anderson, M.M. 1989. Reproductive development in grapes (*Vitis vinifera* L) : Response to seasonal water deficit. *American Journal of Enology and Viticulture* **40** (1) : 52-60.

McCarthy, M.G. 1997. The effect of transient water deficit on berry development of Cv. Shiraz (*Vitis vinifera* L). *Australian Journal of Grape and Vine Research* **3** (3) : 102-108.

Nijjar, G.S. and Chopra, H.R. 1972. Studies on irrigation of grape (*Vitis vinifera* L) Var. Anab-e-Shahi. *Punjab Hort. J.* **12** (4) : 218-227.

Nijjar, G.S. and Sharma, I.J. 1973. Effect of different levels of irrigation on vine growth, yield and fruit quality in grape (*Vitis vinifera* L) Cv. Anab-e-shahi. *Haryana J. Hort. Sci.* **2** (3-4) : 1-9.

Peacock, W.L., Christensen, L.P. and Andris, H.L. 1987. Development of a drip irrigaiton schedule for average canopy vineyards in San Joaquin valley. *Am. J. Enol. and Vitic.* **38** : 113-119.

Prakash, G.S. 1998. Dogridge a rootstock with multipurpose uses, Drashavritta. *Souvenir*, 111-115.

Ramteke, S.D. R.G. Somkumar and J. Satisha 1999. Response of Tas-A-Ganesh vines on Dogridge Rootstock to Imposed water stress. National Dialogue on sustainable the productivity of Grapes under Adverse Situaitons, June 7-8, 1999, Pune. pp-46-50.

Satyanarayana, G. 1982. Problem of grape production around Hydrabad. Technical Bulletin, A.P. Agric. Univ., Hydrabad, pp. 36-40.

Srinivas, K., Shikhamany, S.D. and Reddy, N.N. 1999. Yield and water use of Anab-e-shahi grape (*Vitis vinifera*) vines udner drip and basin irrigation. *Indian Journal of Agricultural Science* **69** (1) : 21-23.