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Short communication

Effect of method and interval of irrigation on plant growth, yield and quality of grape cv. Pusa Navrang

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ABSTRACT

An investigation was carried out at the Malancha Farm under Srinekatan, Shantinekatan Development Authority, Government of West Bengal, Bolepur, Birbhum, West Bengal on 4-year-old vines of Pusa Navrang planted at 2 m × 3 m on Y-trellis to know the effects of method and interval of irrigation on growth dynamics, yield and fruit quality. There were 6-irrigation treatments, *viz*., basin irrigation @ 16 t/vine daily, 1-day interval, 2-day interval; drip irrigation @ 16 l/vine daily, 1-day interval and 2-day interval. Drip irrigation at one day interval resulted in highest yield increment (33.3%) with higher bunch and berry weight and better fruit quality. Regarding irrigation strategy, vines should be irrigated daily after pruning to 2-leaf stage, 1-day interval from flowering to near fruit maturity and 2-day interval during fruit maturity for better growth dynamics, fruit yield and fruit quality.

Key words: Grape, growth dynamics, irrigation, quality, laterite soil and yield.

Grape (*Vitis vinifera* L.) is one of the important export oriented fruit crops in India, commercially grown in different regions in the country having varied climatic conditions. In all commercial regions of the country, table grapes, which accounted for 80%, are produced for fresh consumption and export, 18% for raisin and rest 2% for juice and wine only (Singh, 10). Demand of grape juice and wine is increasing worldwide due to its health benefits. Among the different cultivars available in India, Pusa Navrang (Madeleine Angevine × Ruby Red) is one performing well on laterite soils of West Bengal (Ghosh *et al.*, 5,6). It is established that irrigation in grape is an essential requirement for vine growth after pruning, fruit production and maintaining its vigour for longer vine-life. For irrigating vineyards, drip irrigation is commonly practiced in commercial grape growing states. There are published literatures on effect of method of irrigation, quantification of irrigation water through drip *etc*. are applicable to respective grape growing region in the country. However, in West Bengal, no work on any aspect of irrigation has been done earlier. Generally, ring or basin and drip are followed. Although, drip is the best method of irrigation but it requires initial high monetary investment and electricity availability.

The investigation was taken up during 2011-13 on 4-year-old grapevine of cv. Pusa Navrang planted at spacing of 2 m (plant to plant) × 3 m (row to row). The farm is situated at 23°67' N latitude and 87°72' E longitude at an elevation of 58 m above msl. The top soil of the orchard was collected before starting of the experiment and analysed. Soil of vineyard was laterite, acidic, porous with low water holding capacity. The pH of the soil was 5.7, available N, P and K were 313.5, 32.5 and 111.0 kg/ha. The vines have been trained on Y trellis system. There were six irrigation treatments, *viz*., Basin irrigation (@ 16 l/ vine daily, one day and two day intervals; drip irrigation (@ 16 l/ vine daily, one day and two day intervals. The treatments were applied following randomized block design having six replications with three plants in each replication. Basin irrigation was done manually. Discharge rate of water per dripper was 2.0 l/h. The irrigation treatment was given after pruning to fruit maturity. The irrigation was stoped at 2 leaf stage to panicle emergence. The irrigation treatment was finally stopped 7 days before harvest in each year. Observations were made on fruitfulness of spur, mortality of fruiting spur, renewality of spur, length of renewal and fruiting shoots, leaf number of renewal and fruiting shoots, fruit yield, bunch weight, 10-berry weight and fruit quality with regard to juice per cent, TSS, acidity and ascorbic acid. Fruitfulness of fruiting spur was measured by total number of fruiting shoots kept per vine at the time of pruning and total number of fruiting shoots produced bunches. Mortality of fruiting pruned spur was observed by total number of fruiting shoots kept per vine at the time of pruning and total number of fruiting shoots died after two month of pruning. Renewality of pruned shoots was noted by total number of renewal shoots kept

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per vine at the time of pruning and total number of renewal shoots sprouted after two month of pruning. Length of renewal and fruiting shoot, leaf number of renewal and fruiting shoot were observed 45 days after pruning. Five bunches were weighed from each plant and average bunch weight was calculated and expressed in grams. The TSS was measured by hand refractometer while acidity, total sugars and ascorbic acid content of fruit were determined following standard methods (AOAC, 1).

The results of the present investigation clearly indicated that method and interval of irrigation had significant effect on pruned shoots (spurs), kept for fruiting and renewality. Fruitfulness and renewality of spurs is directly related to fruit production in the current and subsequent year. Fruitfulness and renewality of spurs significantly varied due to method and interval of irrigation (Table 1). Drip irrigated vines had higher fruitfulness (90-98%) and renewality of spurs as compared to basin irrigation (72.8-90.8%) at corresponding irrigation intervals. Renewality of spurs, which determines the next year's yield, was highest in daily irrigated vines (96.3-96.5%) irrespective of method of irrigation. Besides, mortality of fruiting spurs was also lowest in daily irrigated vines irrespective of method of irrigation. These findings clearly indicated that vines to be irrigated daily after pruning and to be continued before emergence of floral primordial (2-leaf stage). Fruitfulness of spurs was highest (98.0%) in the vines with drip irrigation at one-day interval. It indicated that the vines to be irrigated at one-day interval after panicle emergence to get more yield.

Length of renewal and fruiting shoots were more in both the cases in drip irrigated vines as compared to basin irrigated vines at corresponding irrigation intervals (Table 1). Shoot length of renewal and fruiting shoot was highest in daily irrigated vines irrespective of the method of irrigation. Like shoot extension, leaf production in renewal and fruiting shoot was also more in drip irrigated vines as compared to basin irrigation irrespective of interval of irrigation (Table 1). Leaf number was maximum in daily irrigated vines irrespective of the method of irrigation. This growth dynamics in respect of shoot extension and leaf production indicated to adopt irrigation daily after pruning. The practice will be helpful for better accumulation of carbohydrates & other assimilates in the shoots for better vine growth and fruiting.

Method of irrigation as well as irrigation interval had a significant effect on vine yield. In general, drip irrigation resulted in higher yield as compared to basin irrigation irrespective of irrigation intervals throughout the period of investigation. In basin method, irrigation at 1-day interval gave the highest average yield (5.7 kg/ vine) as compared to daily irrigation (3.2 kg/ vine) (Table 1). Results suggested that this practice should be followed in the areas where drip irrigation may not be possible. In drip method, irrigation at one-day interval also resulted in highest yield (7.6 kg/ vine) as compared to all irrigation treatments (Table 1). Highest yield in the vines with drip irrigation at 1-day interval was due to maximum number of fruitful spurs (98.0%). Fimbres-Fontes *et al.* (4) opined that increased yield in drip irrigated vines may due to higher fruitfulness, increase berry set and reduce berry drop. There are many reports indicating superiority of drip method of irrigation over basin or ring under various locations and cultivars (Sarkar and Hanamashetti, 8; Sharma

Table 1. Effect of method and irrigation interval on growth dynamic and fruit yield in grape cv. Pusa Navrang.

Treatment	Growth dynamic (Av. of 2-years)							Fruit yield (kg)/vine		
	Spur fruitfulness (%)	Spur renewality (%)	Fruiting spur mortality (%)	Length of renewal shoot (cm)	Leaf No. of renewal shoot	Length of fruiting shoot (cm)	Leaf No. of fruiting shoot	1st year	2nd year	Pooled
Basin irrigation										
Daily	72.8	96.5	3.3	34.2	11.8	46.7	15.2	2.6	3.8	3.2
1-day interval	90.8	92.5	5.3	31.2	10.7	44.5	15.0	4.9	6.5	5.7
2-day interval	89.3	91.4	6.0	31.2	10.5	39.0	14.0	3.9	5.9	4.9
Drip irrigation										
Daily	97.0	96.3	2.3	41.5	12.7	53.5	16.0	6.4	7.6	7.0
1-day interval	98.0	96.0	3.2	35.7	11.3	44.7	14.0	7.0	8.2	7.6
2-day interval	90.0	93.0	9.6	32.7	10.8	43.7	13.2	5.8	6.2	6.0
$CD_{0.05}$	3.9	2.5	1.5	2.1	0.9	3.6	1.1	1.7	1.9	1.8

Table 2. Effect of method and irrigation interval on bunch & berry weight and fruit quality of grape cv. Pusa Navrang.

Treatment	Bunch wt. (g)	10-berry wt. (g)	Juice (%)	TSS (°Brix)	Acidity (%)	TSS/ acid ratio	Total sugars (%)	Ascorbic acid (mg/ 100 ml juice)
Basin irrigation								
Daily	176	11.2	63.8	15.6	1.00	15.6	11.3	2.8
1-day interval	189	11.6	64.7	15.8	1.00	15.8	11.9	2.5
2-day interval	220	16.1	74.5	16.6	0.67	24.8	12.8	4.8
Drip irrigation								
Daily	212	11.4	64.9	16.4	0.98	16.7	12.7	3.2
1-day interval	221	18.7	70.0	17.4	0.66	26.4	13.2	3.5
2-day interval	219	18.6	72.1	17.8	0.66	26.9	13.9	3.4
$CD_{0.05}$	27.81	1.63	2.90	0.36	0.16	1.44	0.83	NS

et al., 9). The present investigation was aimed to establish how much yield improvement can be made over conventional basin method in red laterite soil. It was calculated that 33.3% yield increment was observed by drip irrigation at 1-day interval over basin irrigation at same intervals using equal volume of water/vine.

Bunch and berry weight are considered to be important parameters for yield determination as well as market price. Method and irrigation intervals had significant effect on both these yield contributing attributes. Drip irrigated vines produced higher bunch and berry weight as compared to basin irrigation irrespective of intervals of irrigation. Among the treatments, drip irrigation at 1-day interval resulted in the highest bunch weight (221 g) and 10-berry weight (18.7 g). The lowest bunch and 10-berry weight were recorded from the vines with basin irrigation daily (176.0 and 11.2 g, respectively). Higher bunch and berry weight in drip irrigated vines may be to more efficient use of applied water for better physiological activity in vines, which in turns resulted in synthesis of more carbohydrates and other reserved foods and translocation of water to berry.

Significantly higher TSS/ acid ratio was noted from the vines received drip irrigation as compared to basin irrigation at corresponding intervals of irrigation (Table 2). Maximum TSS/ acid ratio of 26.9 was determined from the vines received irrigation through drip at 2-day interval and minimum (15.6) was with daily basin irrigation. Irrigation at 2-day interval resulted in maximum TSS, total sugars and TSS/ acid ratio irrespective of method of irrigation. It is suggested that drip irrigation at near maturity stage should be followed at 2-day interval instead of 1-day. Araujo *et al.* (2) also opined that different irrigation amounts were required for the vines, which varied from pruning to fruit set, fruit set to veraison and veraison to fruit maturity. Quality improvement in grapes due to drip irrigation was also observed by Burg (3) and Matouk *et al.* (7). Ascorbic acid content in grapes was generally low irrespective of the treatments and did not vary due to different irrigation treatments.

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