AUTO-DRIP IRRIGATION SCHEDULING WITH E-6 HYBRID STATION CONTROLLER AND PRODUCTION OF NAGPUR MANDARIN
(Citrus Reticulata Blanco)

P.S. Shirgure¹ and G.S. Panchariya²
¹Department of Soil and Water Conservation Engineering, National Research Centre for Citrus, Nagpur (M.S.)
²International Crop Research Institute for Semi Arid Tropics (ICRISAT), Patancheru, Hyderabad (A.P.)

ABSTRACT

The hybrid station controller based automatic irrigation scheduling field experiment was conducted on 10–12 years old bearing Nagpur mandarin (Citrus reticulata Blanco) at National Research Centre for Citrus, Nagpur during 2008–2011. The objective was to study the automatic daily irrigation scheduling as well as alternate day based on time schedule and potential evapo-transpiration through the drip irrigation. The treatments were consisted of Automatic daily irrigation with 60 minute interval three times (I₁); Automatic irrigation daily with 90 minute interval two times (I₂); Automatic irrigation at alternate day with 120 minute three times (I₃); and Automatic irrigation at alternate day with 180 minute two times (I₄) with six replications in Randomized Block Design. The automatic hybrid station controller E-6 (Rain Bird, USA) was used for micro-irrigation schedule setting the time for each treatment based on the water need of the plant and average open pan evaporation. The various scheduling treatment timings were programmed in A, B and C programs of the hybrid station controller. The sustainable production of Nagpur mandarin is possible with drip irrigation using automatic scheduling daily or on alternate days. The water use in October varied from 65.0–72.4 liters/day/plant and during May–June it was 133.0–147.7 liters/day/plant. Drip irrigation was scheduled to maintain automatically the soil moisture status above 25% (wet basis) during fruit growing period. The leaf nutrient status was high with automatic alternate day drip irrigation schedule. The canopy temperature was positively influenced with automatic drip irrigation schedules. The Nagpur mandarin fruit yield was highest (30.91 tones/ha) with irrigation on alternate day 120 minutes three times, followed by irrigation scheduled with 90 minutes interval two times daily (30.11 tones/ha). Fruit weight (154.7g), TSS (10.22°Brix) and juice per cent (40.77%) was found with automatic irrigation at alternate day with 120 minute three times. The automatic drip irrigation scheduling can be a better substitute for manual drip irrigation operation and enhancing the water use efficiency.

Nagpur mandarin is grown in 1.48 lakh ha area with production of 8.75 lakh tonnes. The productivity is low due to water stress, improper and calendar method of scheduling, the gravity irrigation method and inadequate soil moisture during the critical plant growth and fruit developmental stages. Due to increasing scarcity of water, the conventional irrigation methods are being replaced with drip irrigation systems in Nagpur mandarin orchards. But the drip system is not operated regularly maintaining the correct irrigation intervals with manual operation the irrigation interval uniformly is not maintained properly. The productivity potential of the mandarin can be enhanced with the adoption of the modern drip irrigation systems under tree micro-jet irrigation systems (Shirgure et al., 2003) and quality fruits with micro-irrigation and fertigation technology (Shirgure et al., 2001) and automation (Shirgure et al., 2005). The objective was to investigate the conversion of the existing drip irrigation system in Nagpur mandarin orchard to automatic drip irrigation scheduling system using Controller and to maintain uniform and continuous soil moisture in root zone, besides increasing the yield and quality. The automatic irrigation scheduling experiment was conducted in the block of 0.25 ha with 6 spacing at experimental farm of NRCC, Nagpur. The texture of the soil was clay loam and depth of the soil is 41 cm. The FC and PWP of the field under study was 30.44% and 19.56% respectively. The available water content of the soil was 10.89%. The bulk density of the soil in field was determined using core sampler having 100 cm³ volume and oven drying. The bulk density of the field was 1.34 g/cc. The water holding capacity of the soil was 14.59 cm/m depth of soil. The initial plant growth parameters and increase in vegetative growth parameters were recorded during 2008–11. The total fruits harvested from each tree were weighed for computing the yield.

The pan evaporation ranged from minimum 3.4 mm per day in December to maximum 12.7 mm per day in May. The quantity of water given to the mandarin plants was 46.9 to 55.4 litres/day/plant (November–December, 2009) and it was maximum (118.4 to 129.1 litre/day/plant (May 2011). The same was 65.00 to 72.4 litres/day/plant during and 133.04 to 147.7 litres/day/plant during May, 2010. The soil moisture was monitored at higher level (above 25% wet basis) in the treatment I₂ and I₄. It is clear that the automatic irrigation schedules affected the soil moisture and it was higher during the critical summer months from March to June. This clearly indicates that soil moisture was maintained higher in automatic irrigation treatment I₂ and I₄, which have higher and continuous flow rates. The average height of the Nagpur mandarin plant ranged from 5.10–5.42 m, stock girth from 71.75–76.03 cm. The significant difference was
observed in canopy volume also, ranging from 64.56–87.81 m³. The average plant and stock girth was higher in automatic irrigation treatment I4 followed by automatic irrigation treatment I2. The average canopy volume observed was significantly higher (87.81 m³) in treatment I4 followed by automatic irrigation scheduled treatment I3 (84.83 m³) as compared to the treatment I1 (66.6 m³) and I3 (64.56 m³) during the year 2008–11. This is mainly due to availability of constant and continuous soil moisture in plant root zone. Yield and quality were significantly influenced by the different automatic irrigation schedules. The average fruit weight and acidity were not significant. The average number of fruits per plant varied from 606 to 726 in different automatic drip irrigation schedules. The number of fruits per plant was highest in the automatic irrigation treatment I4 followed by treatment I1. The various drip irrigation scheduling significantly influenced the yield of the Nagpur mandarin. It increased the yield from 24.5 to 30.91 tonnes/ha. The highest mandarin fruit yield was recorded in the automatic drip irrigation treatment I4 i.e. 30.91 tonnes/ha. The moderate yield was observed in automatic drip irrigation treatment I2 (30.11 tonnes/ha) followed by automatic drip irrigation treatment I2 (27.04 tonnes/ha). The lowest fruit yield was seen in irrigation scheduled treatment I1. This clearly indicated that the automatic drip irrigation schedules on daily and alternate days maintained higher as well as continuous soil moisture influenced by the water and nutrient uptake resulting into good quality fruits besides enhancing the yield. The highest average fruit weight (153.67 g.) and lowest acidity (0.78) is observed in the automatic drip irrigation treatment I4. The TSS (10.22° Brix) and juice per cent (40.77%) was more in the automatic drip irrigation treatment I4. The TSS/acidity is indicator of sweetness of the fruit of Ambia flush. If the TSS to acidity ratio is high means that the fruits have more sweetness and less acidity. The highest TSS/acidity was found in the automatic drip irrigation treatment I4 (13.2) followed by automatic drip irrigation treatment I3 (12.4). The lowest TSS/acidity (11.7) was observed in automatic drip irrigation treatment I1. The automatic drip irrigation scheduling 120 minutes 3 times on alternate day could be a better substitute for manual drip irrigation operation and enhancing the water yield fruit quality.

REFERENCES