Hydraulic performance and modelling of pressurized drip irrigation system

ABSTRACT

This study was conducted at Laman Sayur, Malaysia Agro Exposition Park Serdang (MAEPS), to investigate the hydraulic performance of a small-scale drip irrigation system. The modelling was carried out using EPANET software to understand how the drip irrigation system is operated. Model results show that the errors are small, i.e., 2.2% and 3.0% for pressures, and 1.7% for discharge in lateral pipe 1 and lateral pipe 2. The root mean square error (RMSE) and the mean bias error (MBE) for discharge were recorded at 0.04 L/h and 0.03 L/h for lateral pipe 1 and 0.04 L/h and 0.02 L/h for lateral pipe 2. RMSE and MBE for pressure were recorded at 0.61 m and 0.68 m for lateral pipe 1, and 0.79 m and 0.68 m for lateral pipe 2, respectively. These results show that the model yields good performance. For hydraulic performance, the field measurement was conducted with four operating pressures: P1 (15.3), P2 (20.4), P3 (25.5), and P4 (28.6) meters. The hydraulic parameters evaluated were the coefficient of uniformity (CU), the emission uniformity (EU), the coefficient of variation (CV), and the emitter flow variation (EFV). The operating pressure during the measurement is constant according to the specified pressure. The results show that CU, CV, and EU are in the excellent classification, and values of CU and EU have more than 95% efficiency. The value for CV is below 0.03, which is excellent. The EFV is 10% when operating at 25.5 m and 15.3 m and is considered desirable. On the other hand, for the 28.6 m and 15.3 m operating pressures, the EFV parameters were recorded at 13.6% and 10.29%, respectively, and are classified acceptable. This study concluded that the operating pressures, P2 (20.4 m) and P3 (25.5 m), were performed under excellent classification for all hydraulic parameters evaluated. Based on the outputs from the model, it is inferred that the existing drip irrigation system at Laman Sayur MAEPS is operated in an over-powered state. With the current pump power consumption, the irrigation system could be operated at a minimum of four times the capacity of the existing irrigation system. To reduce the power consumption, it is suggested that the system is operated at a lower pumping power. This would minimize the operating costs especially for the development of a new drip irrigation system that has the same capacity as the drip irrigation system that is currently being operated at Laman Sayur, MAEPS Serdang.

Keyword: Drip irrigation system; Coefficient of uniformity; Emission uniformity; Coefficient of variation; Emitter flow variation