Modelling actual evapotranspiration using optimized ENN methods

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Abstract Elman neural network (ENN) optimized by Mind Evolutionary Algorithm (MEA) and Genetic Algorithm (GA) was used to predict the accuracy of actual evapotranspiration (ET) in the MFR-RDI, and canopy temperature (Tc) was introduced as one of the input factors of the model.The results show that the introduction of Tc can improve the accuracy of the prediction model. Under the same input factors, the performance of MEA-Elman model is better than GA-Elman model. In addition, choosing different input factors in different growth periods of crops can further improve the prediction accuracy of ET.

Keywords: Evapotranspiration; Canopy temperature; Elman Neural Network; Mind Evolutionary Algorithm; Genetic Algorithm

Methods

The rainwater harvesting partial plastic film mulching and regulated deficit irrigation (MFR-RDI) with straw mulling, had been employed to save irrigation water.

- The soil water balance method was used to determine ET.
- Canopy temperature, Leaf area index and plant Heights were measured.
- Elman Neural Networks optimized by GA.
- Elman Neural Networks optimized by MEA.
- .Data from 2014 to 2017 were used for training, and data from 2018 were used for prediction and evaluation.
- Root mean square error (RMSE), mean absolute error (MAE) and Nash-Sutcliffe coefficient (NS) were used to evaluate the model performance.

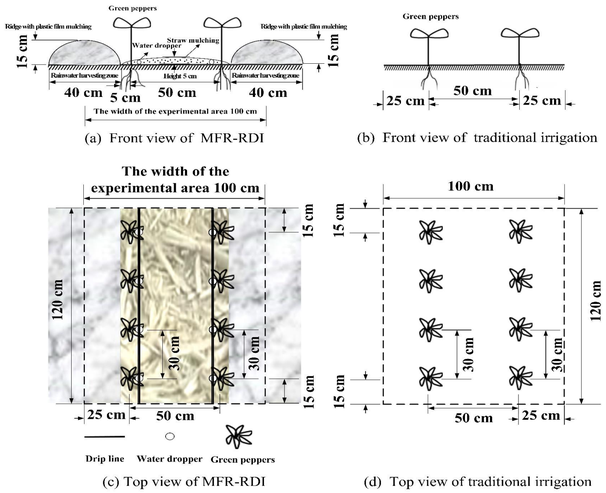

Figure *1:A schematic diagram of MFR-RDI system and traditional irrigation taking green pepper as an example.*

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Results

- Rainwater harvesting of straw mulching cultivation mode (MFR-RDI) can provide more suitable for crop growth of soil temperature and maintained high soil moisture content for crop growth. MFR-RDI can improve water use efficiency.
- The canopy temperature can well improve the accuracy of both MEA-Elman and GA-Elman models in predicting ET under MFR-RDI planting mode.
- The MEA-Elman model was better than the GA-Elman model when the same variables were input.
- Selecting different input variables in different growth stages of crops played a positive role in improving the accuracy of ET prediction.

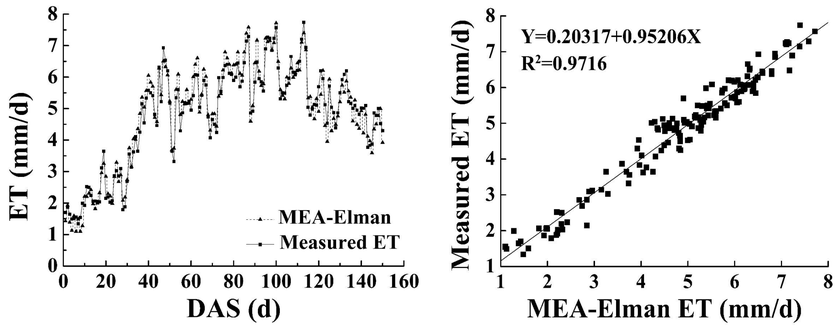

Figure *2:Comparison and analysis of the measured and predicted ET in selecting different input variables in different growth stages of crops .*

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Conclusions

MFR-RDI can improve water use efficiency. Leaf area index and canopy temperature had a large influence on the prediction of ET. Canopy temperature could be used as one of the important factors to predict ET. In case of the same input factors, the MEA-Elman model was generally better than the GA-Elman model. Different factors were selected as input variables for different growth periods to predict ET of crops, and the prediction effect was good.

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