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加工番茄地上部干物质分配与产量预测模拟模型

Simulation of shoot dry matter partitioning and yield prediction of processing tomato

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中文摘要:

为了探究加工番茄在滴灌栽培条件下地上部干物质分配动态和产量形成过程，该文通过定量分析加工番茄的生长发育特征，设置不同品种的播期试验，构建了基于分配指数(partitioning index，PI)和收获指数(harvest index，HI)的加工番茄地上部干物质分配与产量预测的模拟模型。利用与建模数据相独立的试验资料对模型进行了初步检验，结果表明，模型对不同播期、品种的加工番茄各生育期（出苗至开花、开花至坐果、坐果至红熟、红熟至拉秧期）干物质量，全生育期总干物质量、地上部茎、叶、果干质量的预测结果与1:1直线间的R2分别为0.9754、0.9936、0.9840、0.9713；0.9856；0.9595、0.9798、0.9671；RMSE和RE分别为0.029 t/hm2、11.43%；0.074 t/hm2、5.09%；0.250 t/hm2、6.83%；0.102 t/hm2、5.71%；0.504 t/hm2，8.06%；0.332 t/hm2，14.62%；0.200 t/hm2，10.84%；0.549 t/hm2，18.30%。模型对加工番茄产量的预测结果与1:1直线间的R2为0.9658，RMSE和RE分别为5.806 t/hm2、8.07%。该模型对于不同播期、品种的加工番茄干物质分配与产量的预测值与模拟值之间符合度较高，表明模型具有较好的预测性和适用性。该研究可为滴灌加工番茄精准栽培提供理论参考。

英文摘要:

Abstract: At present, Xinjiang produces about 90% of total processing tomato production in China, and which has become the most important and the largest producer of processing tomatoes in China. Light, heat, water, and soil are the vital components of special ecological factors, ensuring high quality, high yield, and high efficiency of processing tomatoes in Xinjiang. Compared with traditional furrow irrigation, one of the new irrigation strategies of crop production is drip irrigation. The introduction of drip irrigation in Xinjiang has provided the means to increase crop production and water use efficiency. When drip irrigation was used to grow processing tomatoes in Xinjiang, its yield and quality far exceeded the average level in China. However, no previous studies have examined the development and dry matter partitioning of Xinjiang's drip irrigated processing tomatoes. Simulation models of crop growth and production provide a widely accepted tool for assessing agricultural production opportunities in different agro-ecological zones in response to weather and management. Thus, the aim of the present study was to develop model for the growth and production of drip irrigated processing tomatoes in Xinjiang.Field experiments were conducted in three subsequent years in Shihezi, Xinjiang, China. The relationships between the partitioning indexes of organ dry matter and physiological development time (PDT) were systematically studied with the experiment of different sowing dates and varieties. And simulation models for shoot dry matter partitioning and yield in drip irrigated processing tomato were developed based on a partitioning index (PI) and a harvest index (HI) in which the PI of leaves and the HI were the functions of PDT, which were also altered by relative thermal effectiveness (RTE), relative photoperiod effectiveness (RPE), and intrinsic development factor (IDF). Model validation with three years of weather and independent crop growth data showed that the growth and yield of processing tomatoes are simulated satisfactorily. R2, root mean square error (RMSE) and relative estimation error (RE) of simulated and observed dry matter under four different growing stages (emergence to flowering, flowering to fruit-setting, fruit-setting to maturing, and maturing to ending date), total dry weight of whole growth period, stem dry weight, leaf dry weight, and fruit dry weight were 0.9754, 0.029t/hm2, 11.43%; 0.9936, 0.074t/hm2, 5.09%; 0.9840, 0.250t/hm2, 6.83%; 0.9713, 0.102t/hm2, 5.71%; 0.9940, 0.504t/hm2, 8.06%;0.9629, 0.332t/hm2, 14.62%; 0.9828, 0.200t/hm2, 10.84%; 0.9585, 0.549t/hm2, and 18.30%. The R2、RMSE, and RE between the predicted and the measured yield based on the 1:1 line were 0.9658, 5.806t/hm2, and 8.07%, respectively, which indicated that the model could predict well the dynamic accumulation of dry matter in different organs under diverse conditions of a drip irrigated processing tomato. We concluded that this model provide a tool to assess development, growth and production of processing tomatoes in various ecological zones in response to temperature and incoming radiation.

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