



The Effect of Climate Change on Potato (*Solanum tuberosum* L.) Production in Feridonsahr Region of Isfahan I- Growth and Development

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Introduction

The historical trend of Iran annual average temperature of shows a $0.05\text{ }^{\circ}\text{C}\cdot\text{year}^{-1}$ increase which indicates that future emissions of greenhouse gases will continue to increase temperature and consequently cause to climatic change in the country. This change in environment will have a serious impact on different growth and development processes of crops. Increasing temperature could affect physiological processes like photosynthesis, respiration and partitioning of photo-assimilates. The negative impacts of climate change on potato production are reported in the literature. The present study was conducted to quantify the potential impacts of climate change on phenology, growth and tuber yield of potato.

Materials and Methods

The climate projections of Hadley Centre Coupled Model version 3 (HadCM3), France and Institute of Pierre Simon Laplace (IPCM4), United Kingdom, was used to simulate the future conditions based on A2, B1 and A1B SRES (Special Report on Emissions Scenarios) scenario at three time periods including 2015-2045 (2030), 2046-2075 (2060) and 2076-2105 (2090) with a baseline of 1988-2012 (2012). For each period, the year shown in the parenthesis was considered as target year. The SUBSTOR-Potato model, one of the sixteen models embedded within the DSSAT (v4.5) program, was used to simulate the baseline and future yield and growth characteristics of potato. The model was calibrated and validated during 2012 and 2013 with two different farm experiments. In these experiments, the effects of different amounts of nitrogen fertilizer on yield and morphological traits of three potato cultivars were investigated. Six levels of nitrogen fertilizer (0, 50, 100, 200, 300 and 400 kg urea. ha^{-1}) and three commonly planted potato cultivars in the region (Arinda, Santeh and Agria as early, medium and late maturity varieties, respectively) were studied as a factorial arrangement based on a randomized complete block design with three replications. Several criteria were used to quantify the difference between simulated and observed data. The root mean-squared error (RMSE-N (%)) was computed to measure the coincidence between measured and simulated values, while mean deviation (RMD) was calculated to evaluate the systematic bias of the model and model efficiency (ME) to estimate the model performance in relation to the observed mean.

Results and Discussion

The evaluation of the SUBSTOR-Potato model showed adequate accuracy for simulating tuber yield, LAI, DTA and DTH of potato (Table 3). The results showed that the RMSE-N (%) was low for all the parameters. In both GCMs, number of days from planting to anthesis stages of potato decreased in compare to baseline of Fereydoon-Shahr region. Modeled values of day to anthesis in all scenarios and models (except B1 scenario in HadCM3 model) showed a decrease over the time, with the lowest amount in 2090. Under all scenarios and GCMs, the length of planting to harvest period will be declined in compare to baseline. Tuber yield will decline in compare to the baseline with a reduction range from 11.21% to 27.53% for HadCM3 model and from 12.60% to 30.58% for IPCM4 model. In HadCM3, B1 scenario in 2030 had the least difference with the baseline period (29.15 t ha^{-1}) (Table 5), which is about 11.21% lower than the current condition. In IPCM4 model, the highest

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tuber yield was simulated under B1 scenario in 2030 (25.48 t ha^{-1}), which shows a reduction of about 12.60% in compare to the baseline. A2 scenario in both GCMs showed the lowest tuber yield in 2090 (21.13 t ha^{-1} for HadCM3 and 20.24 t ha^{-1} for IPCM4), means a drop of 27.53% and 30.58% in tuber yield in compare to the baseline. In fact, in A1B, A2 and B1 scenarios, a decline of 20.29%, 27.53% and 16.04% in tuber yield for HadCM3 and a reduction of 20.88%, 30.58% and 17.90% for IPCM4 model was simulated, respectively.

Conclusion

The results indicated that tuber yield of common varieties of potato under all scenarios (A1B, A2 and B1) in both GCMs and during the evaluated years will decline in compare to the baseline in Fereydoon-shahr region.

Keywords: GCM, LARS Model, Scenario, Simulation

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