Iranian Journal of Field Crops Research
Vol. 15, No. 2, Summer. 2017, p. 355-367

نشریه پژوهشهای زراعی ایران
جلد ۱۵، شماره ۲ ، تابستان ۱۳۹۶، ص. ۳۶۷-۳۵۵

Evaluating Canola Yield under Arid and Climate Change Conditions

S. Farhangfar[1]- M. Bannayan[2*]- H. R. Khazaei[2]- M. Mousavi Baygi[3]

Received: 25-10-2015
Accepted: 06-04-2016

Introduction: Climate change has a profound influence on crop production sustainability in arid and semi-arid environments. A more arid climate is usually accompanied by a higher frequency and severity of droughts. Drought prevention and mitigation has become important content of promoting economic and social sustainable development. Assessing vulnerability of agricultural crops is an effective approach in understanding the impacts of climate change and extreme climatic events on agricultural systems. In recent years vulnerability was generally considered as a function of exposure, sensitivity and adaptive capacity. Sensitivity reflects the degree to which a given system responds to the fluctuations in stress. Adaptive capacity has been defined as the capacity of a system to adjust to the change and take advantage from it. Exposure is the possibility of the system being exposed to the concerned change in the stress. This study aims to achieve an understanding of the vulnerability of wheat and maize production, to various severities of drought conditions in the past and coming future years.

Materials and Methods: This study was performed in Mashhad, Sabzevar and Torbat Heydarieh. Daily historical weather data including maximum and minimum air temperature (°C), precipitation (mm) and solar radiation (MJ m^{-2} d^{-1}) for the period of 1961-2008 were collected for each study location from their established climatologic stations. Two general circulation models including IPCM4 and HadCM3 were used under A1B, A2 and B1 emission scenarios using LARS-WG. Historical crop yields of canola were collected for study locations from the established Ministry of Agricultural. The potential canola yield was simulated by the crop growth model WOFOST version 7.1.7. For quantifying drought, Aridity Index (UNEP 1992) was calculated for canola growing season March-October. In this study vulnerability was considered as a function of sensitivity, well-being state relative to its damage threshold and exposure. Sensitivity was calculated as the slope value of the simulated trend line of yield and aridity index during the growing season of canola. The crop production well-being to its damage threshold was calculated as the proportion of the yield of a specific year to the average yield over the selected years. Exposure was calculated as the proportion of years having an AI_U value under the specified level within the concerned period.

Results and Discussion: The estimated agricultural sensitivity showed that in all the study locations canola was extremely sensitive to drought in the baseline; the same trend was obtained in the projected years by both HadCM3 and IPCM4 models (SEN > 200). For all the study locations the estimated values of V_{EXPL}, V_{EXPS} and EV_{EXP} in the baseline were extremely high (> 20), while EEXP was low. It seems that canola production in the baseline have suffered from severe drought. The results of both GCM models showed the same trend under all scenarios as the estimated values of SEN, V_{EXPL}, V_{EXPS} and EV_{EXP} during the coming future years were extremely high, while EEXP was low. It seems that in all study locations drought is going to affect canola production in the coming future years. These negative effects can be related to photosynthesis reduction and decline in the speed and amount of transportation assimilation under drought conditions that causes crop yield and dry matter reduction. Drought also affects plants pollination and causes pollen sterility, which affects crop production. It was reported by Daneshmand *et al.*, 2006 that drought usually affects the grains of canola by reducing the number of seeds in siliqua. It was stated by Ma *et al.*, 2006 that the number of seeds in the siliqua declines under drought conditions. According to the results of Mishra and Cherkauer, 2010 during 1980-2007 the yield of crops showed a strong correlation with drought during the seed filling and reproductive periods in western part of the center United States. It was also reported that drought reduces the morphological traits of canola (bush height, number of sub-branches and the length of siliqua), grain yield and its components (the number of siliqua in a bush, number of seeds in a siliqua and the weight of 1000 seeds) and the oil yield significantly.

1- Ph.D. Graduated Student of Agroecology, Faculty of Agriculture, Ferdowsi University of Mashhad
2- Professor of Agronomy, Faculty of Agriculture, Ferdowsi University of Mashhad
3- Professor of Meteorology, Faculty of Agriculture, Ferdowsi University of Mashhad
(*- Corresponding Author Email: mobannayan@yahoo.com)

Conclusions: Overall, this study results showed that canola production has affected from severe droughts during the baseline years. The results of both GCM models showed the same trend as the baseline. Canola production was extremely sensitive and vulnerable to drought during the baseline and projected years.

Keywords: Sensitivity, Vulnerability, WOFOST model