

Risk modelling of late spring frost damage on fruit trees in Iran, case study; Apple tree, Mashhad Plain

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Mashhad plain is one of the most important regions of apple cultivation in Iran. Late frosts occurring in spring create significant bud damage and decrease the yield of apples in this region. Assessment and risk modeling of frost damage would be useful to manage and decrease the damage. The study area is a part of Khorasan Razavi province which is located in Mashhad plain. This region is located in northeast Iran (36° to 37° N, 58° 30' to 60°E). The area of this region is about 13000 square km, which is about one tenth of the Khorasan province area. In order to model frost damage risk 12 affective parameters were selected, including climatological (minimum temperature, temperature decrease rate, temperature increase rate, Julian date of frost, cumulative degree days, area under zero line, and frost duration) and geographical parameters (elevation, Longitude, Latitude, aspect, and slope). 3 damaging radiative frosts were selected in the period of apple flowering time - 20 April 2003, 8 April 2005, and 28 March 2005. Required meteorological data were collected from 9 meteorological standard stations inside and outside of the study area. Linear multiple regression were used to model the relationship. The map of each parameter was plotted by using suitable interpolation methods including IDW, Spline, and Kriging. A 5 by 5 km grid map was defined in order to extract data for the model. The regression equation is significant at the level of 95% significance. By using this equation, the predicted amounts of frost risk damage were calculated for each grid point and the map was plotted. The regression equation of observed and predicted frost damage risk had a correlation of 0.93 and the error map also was prepared. According to this study in frost of 20 April 2009 southwest parts of the plain were estimated as the most frost risk areas by 53% and the southeast parts were estimated as the least frost risk areas of the plain by 34.5. %