

## NOAA Report

### Scenario Analyses with process-based models (International Potato center)

Simulation models might be the only cost effective option to analyze the expected outcomes of agricultural production under different climatic, soils, and management conditions. In order to have valid results, the models must be calibrated in situ, to test its validity.

During the reporting period the SUBSTOR potato model was adapted to the climatic conditions of the study areas. A new sub-routine to simulate the effect of frosts during different physiological stages of the plants was developed. Figures 1-4 show the differences between the previous and the modified version of the SUBSTOR model to simulate the impact of frost on potato production. Frost are defined as temperatures equal or less than 0°C. The indicators used to assess the effect of frost were the capacity to harvest light – through the leaf area index (LAI) – and tuber yields.

The simulations included two reference scenarios, the potential production i.e. only limited by temperature and water limited - limited by temperature and water (rainfall & irrigation). The other three scenarios included artificial frost events at early, intermediate and late stages of the production cycle. Both indicators evidenced that the impact of frost is better simulated with the improved model.

The species of *Solanum tuberosum* ssp. -meaning sub-specie- *Andigena* and *Solanum juzpeckzuki* are recommended to improve the potato production in zones when temperatures are normally below 0°C or in areas with a short frost-free period. Experiments conducted with these species and sub-species were used to validate the improved model.

Figure 5 shows the distribution of minimum temperatures in the validation site, over one calendar year. Figure 6 shows the closeness of fit between experimental and simulated yields. The level of agreement is quite good.

Figure 7 shows the cumulative probability density function over nine weather-years (1990 – 1999) for the study site in Bolivia. The sub-specie tuberosum is not suited for the area but it was included as a reference. Seven out of the nine years the two varieties promoted as frost tolerant varieties produce acceptable yields. In years with no frost, the yields can go as high as 12 t.ha<sup>-1</sup>. The non-tolerant variety only produces in years with no frost. Even then the yields are so low it is not worth even trying it, as farmers rightly do.

For an area near the site in Puno, the impact of using irrigation to cope with the frost problem was simulated. The area will soon have access to irrigation that is why the alternative scenario was simulated. The results shown in figure 8 indicate that with irrigation early planting to avoid the late frost, which have the greatest negative impact on potato yield, highly increase production. If irrigation is not available, planting date as practiced by farmers is the best option.

Livestock production models have already been validated for the study area. We now have all the models needed to test a portfolio of options to better understand existing and alternative scenarios to cope with extreme climatic events.

### Figures



Figure 1: Old version of SUBSTOR simulating Leaf Area Index (LAI) in all the described scenarios.

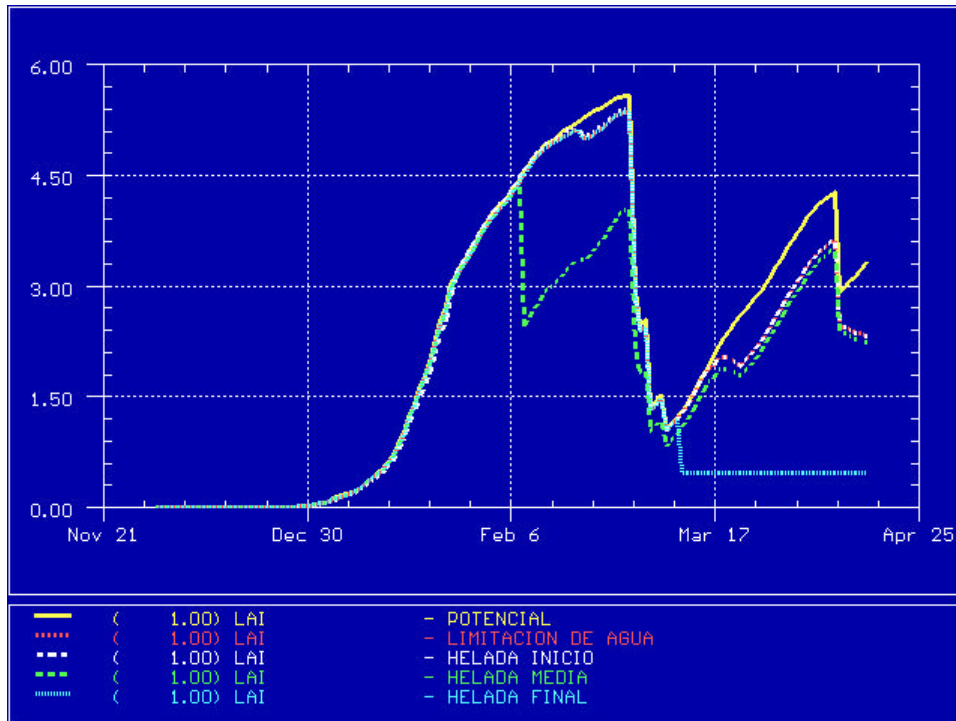


Figure 2: New version of SUBSTOR simulating Leaf Area Index (LAI) in all the described scenarios.

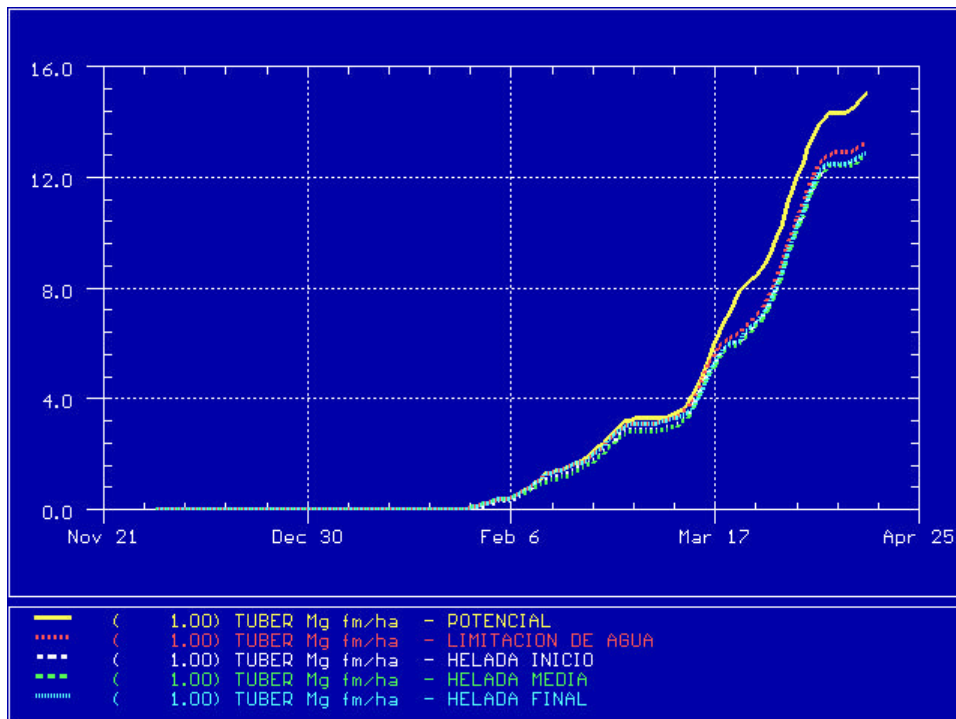


Figure 3: Old version of SUBSTOR simulating potato yield (tn/ha) in all the described scenarios.

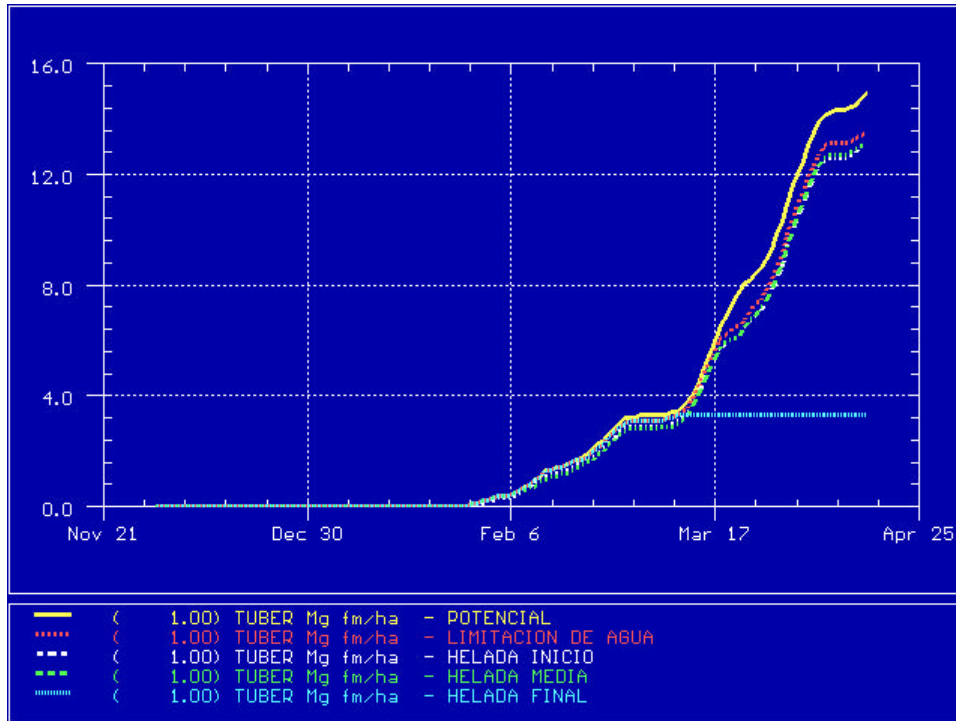


Figure 4: New version of SUBSTOR simulating potato yield (tn/ha) in all the described scenarios.

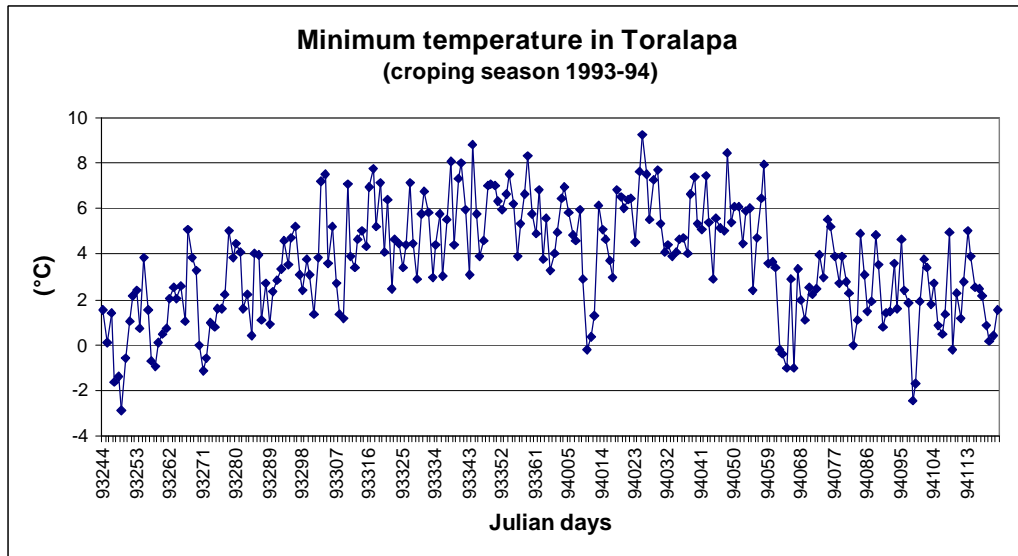


Figure 5: Daily minimum temperatures in Toralapa – Bolivia.

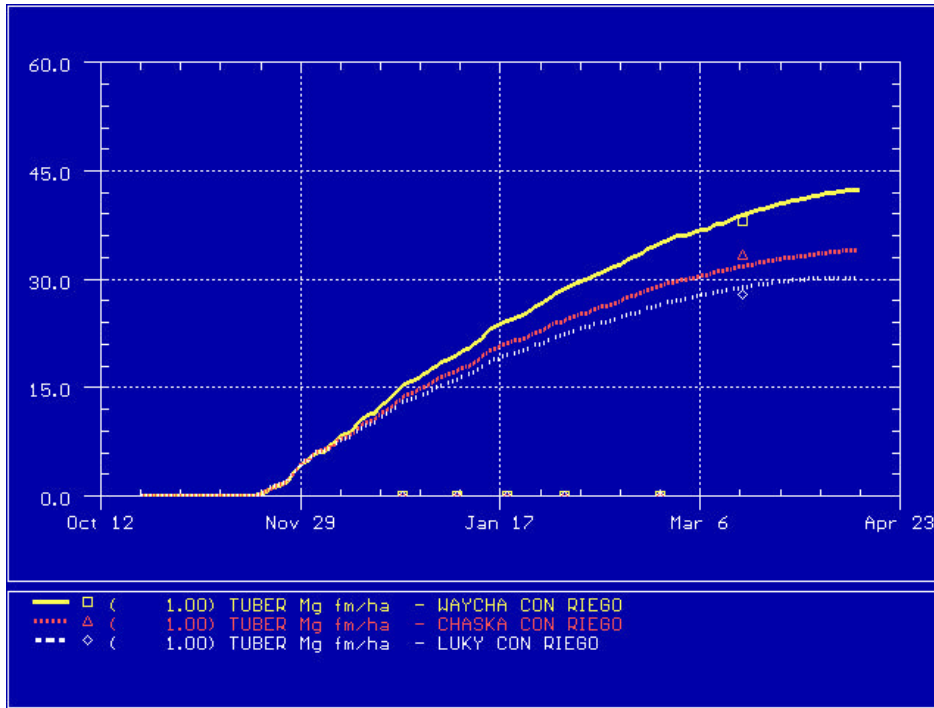


Figure 6. Simulated versus experimental data for three cultivars in Toralapa – Bolivia.

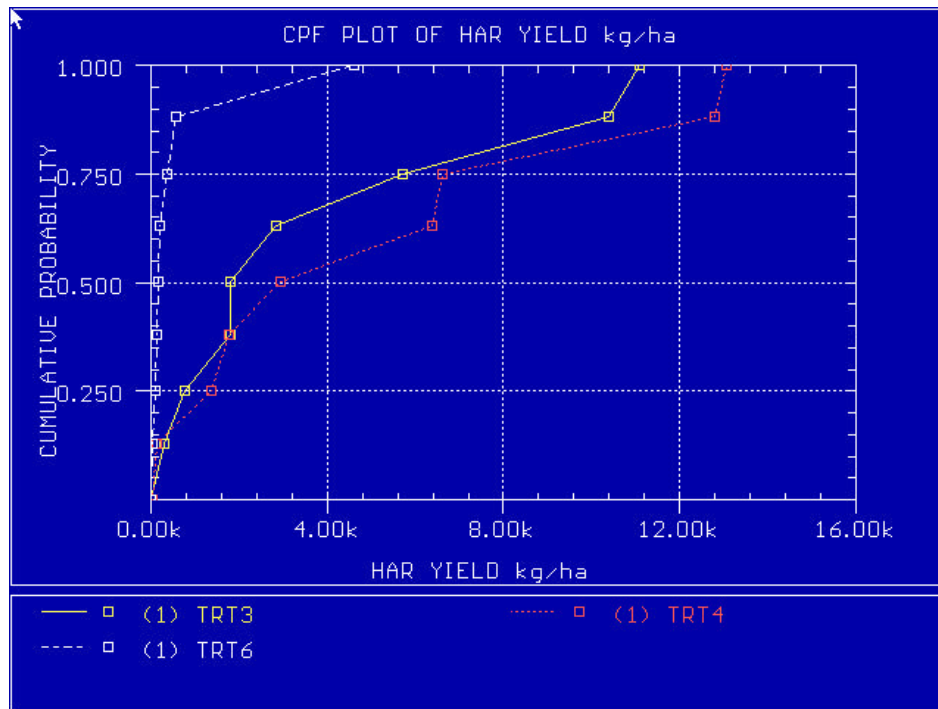


Figure 8: Simulating the potato production during nine cropping seasons (1990-1999) for *S. tuberosum* ssp. *tuberosum* (Treatment 6), *S. tuberosum* ssp. *andigena* (Treatment 4) and *S. juzpeckzuki* (Treatment 3) in Aroma, Bolivia.

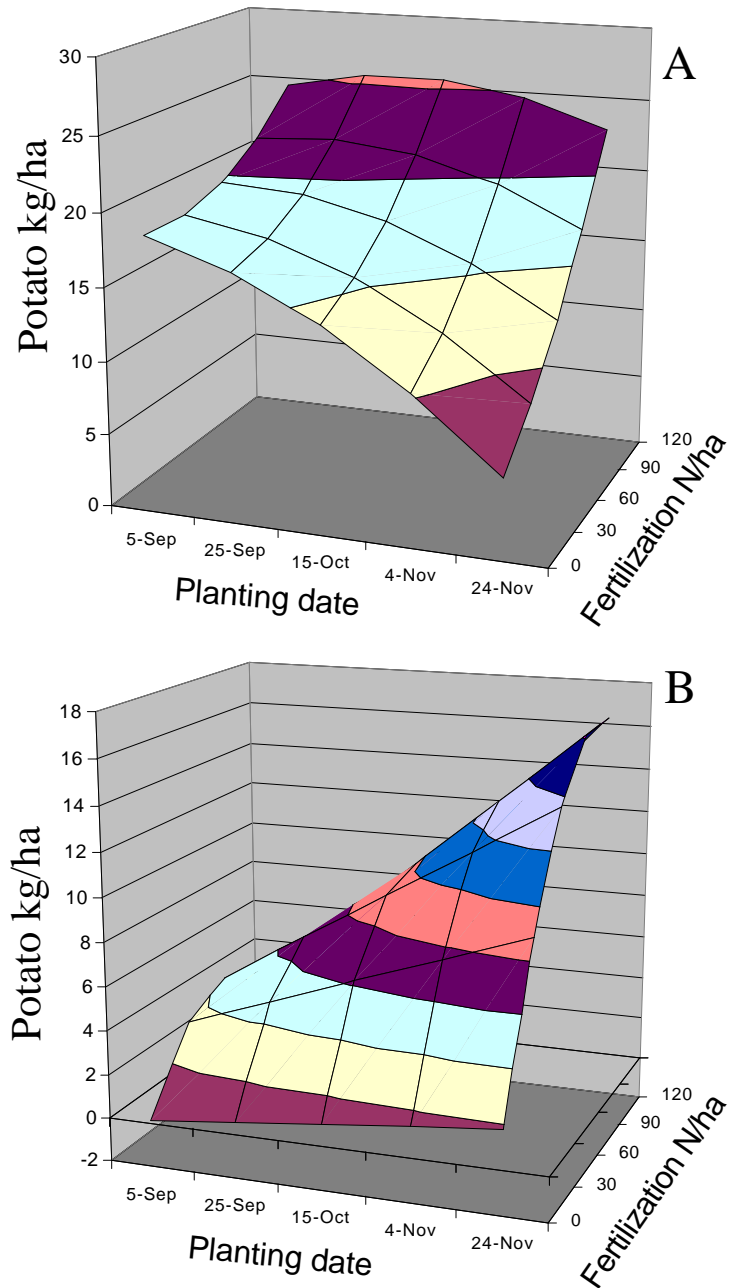


Figure 8. The effect of early planting on potato production with (top) and without (bottom) irrigation: simulated scenarios.