GROWING SEASON FOR MAIZE CULTIVARS WITH CONTRASTING MATURITY AT CENTER-SOUTHERN OF BUENOS AIRES PROVINCE, ARGENTINE: B. FROST RISKS ON DIFFERENT PLANTING DATES

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ABSTRACT: The main objective was to assess the frost risks for maize as affected by planting dates and maturity cultivar over a region exhibiting some trends in temperature-based indices. An approach coupling a probabilistic frost analysis with a model to predict the occurrence of sensitive stages was applied to four locations of the region. Variability of occurrence of four developed leaves (V4) and maturity (R6) in comparison with occurrence of late and early frosts separated distinct levels of risk. Balcarce presented minor risks for late frosts. Late planting should be avoided for long season cultivars. Early maturing cultivars and middle planting dates are more suitable options to reduce the frost damage risk in maize across all locations.
KEY-WORDS: frosts, decision support

ESTAÇÃO DE CRESCIMENTO PARA CULTIVARES DE MILHO DE DIFERENTES GRUPOS DE MATURAÇÃO NO CENTRO-SUDESTE DA PROVINCIA DE BUENOS AIRES, ARGENTINA: B. RISCO DE GEADAS

RESUMO: O objetivo foi avaliar os riscos de geada para milho em uma região que tem se mostrado com tendencias nos principais indices climatologicos baseados em temperatura. Foram avaliados cultivares de constratante maturação ao longo de seis datas de semeadura. Aplicou-se um metodo simples com analise probabilistica de ocorrencia de geadas e ocurrencia de estadios sensiveis. Balcarce presentou menores riscos de geadas tardias. Semeaduras tardias de cultivares de estação prolongada deberiam ser evitadas na região.
PALAVRAS-CHAVE: geadas, soporte de decisão

INTRODUCTION

A late spring frost can do serious damage to maize plants, especially if it occurs on a sensitive developmental stages. After V4 stage (RITCHIE HANWAY, 1982) frost is dangerous because apical meristem is above soil surface level. In addition, an early frost can interrupt the filling grain period. Robles et al. (2012) reported a decreased frost damage risk for early planting date at Balcarce over the last decades. The main objective was to assess the frost

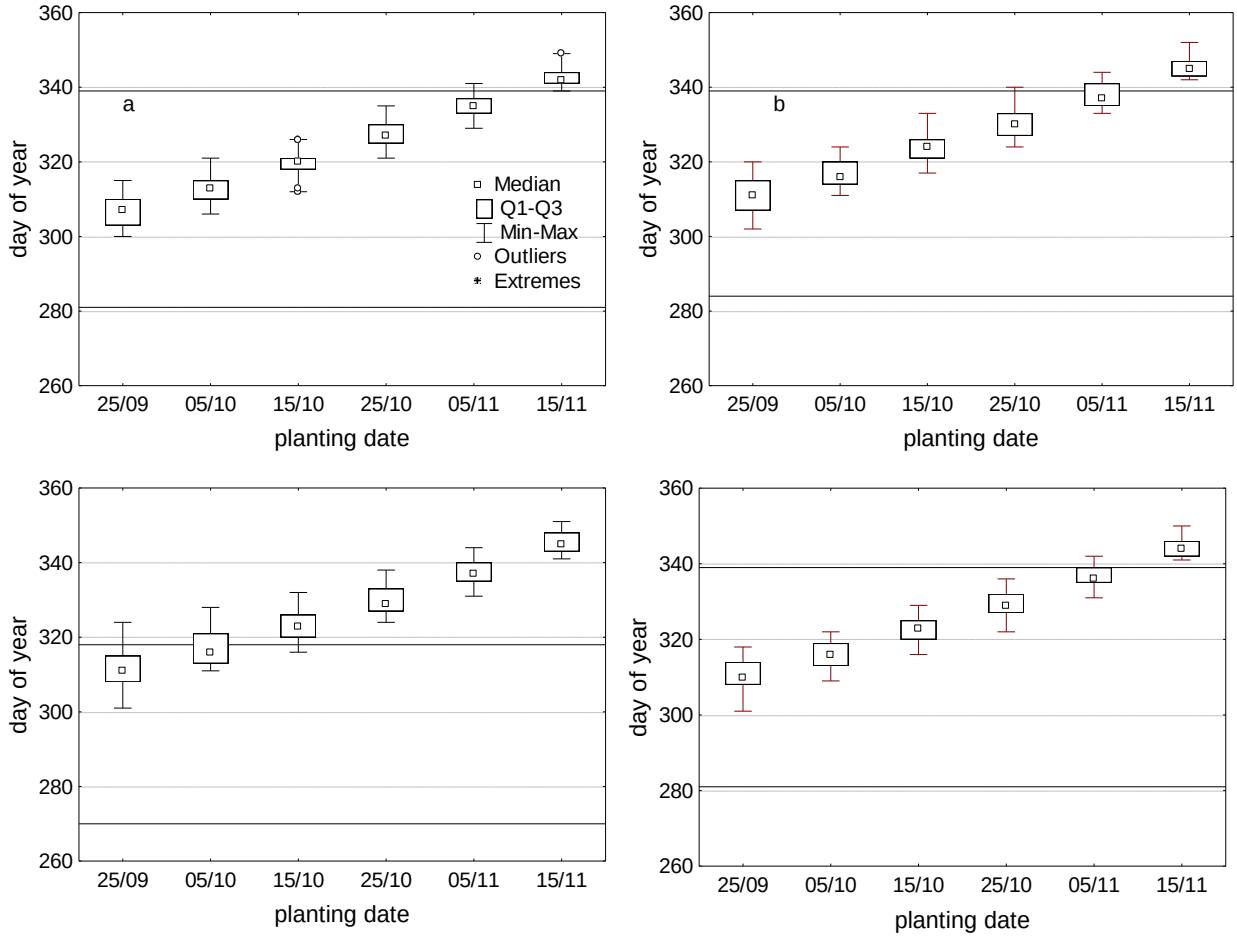
risks for maize as affected by planting dates and cultivar maturity over a region exhibiting some trends in bioclimatological indices (FERNANDEZ LONG et al., 2013).

MATERIAL AND METHODS

Series of minimum and media daily air temperature (1971-2010) from Azul (-36º 50'), Tandil (-37º19'), Balcarce, (-37º45') and Mar del Plata (-38º00') were used. Frost risks in early crop stages were evaluated from occurrence of frost after four expanded leaves stage (V4). Since maize requires about 60 Cd to develop each leaf, the risk of frost damage was assessed by using air temperatures to calculate growing degree days and projected the date at which crop would reach the sensitive V4 stage. Frost risks before maturity (R6) were also evaluated. Growing seasons for three cultivars across planting dates from late September (25/09) to mid-November (15/11) were simulated as cited in Panunzio Moscoso et al. (2013). Spearman analysis was applied to detect trends on occurrence of frosts and V4 stage.

RESULTS AND DISCUSSION

Since thermal time from emergence to V4 stage was similar for all cultivars, differences were evaluated for planting dates and locations. Variability on occurrence of V4 stage and dates of occurrence of late frosts are represented in Figure 1. Balcarce presented the minor risk of occurrence of late meteorological frosts after V4 stage, exhibiting three planting dates completely free of risks. Only the late planting date had no risks after V4 stage in all location.



Variability of maturity dates are presented with early frosts at Figure 2.

Figure 1 - Box-plots of predicted dates of occurrence of V4 stage grouped by location and planting date. a. Azul. b. Tandil. c. Balcarce. d. Mar del Plata. Solid lines indicate the occurrence of media and extreme late meteorological frosts.

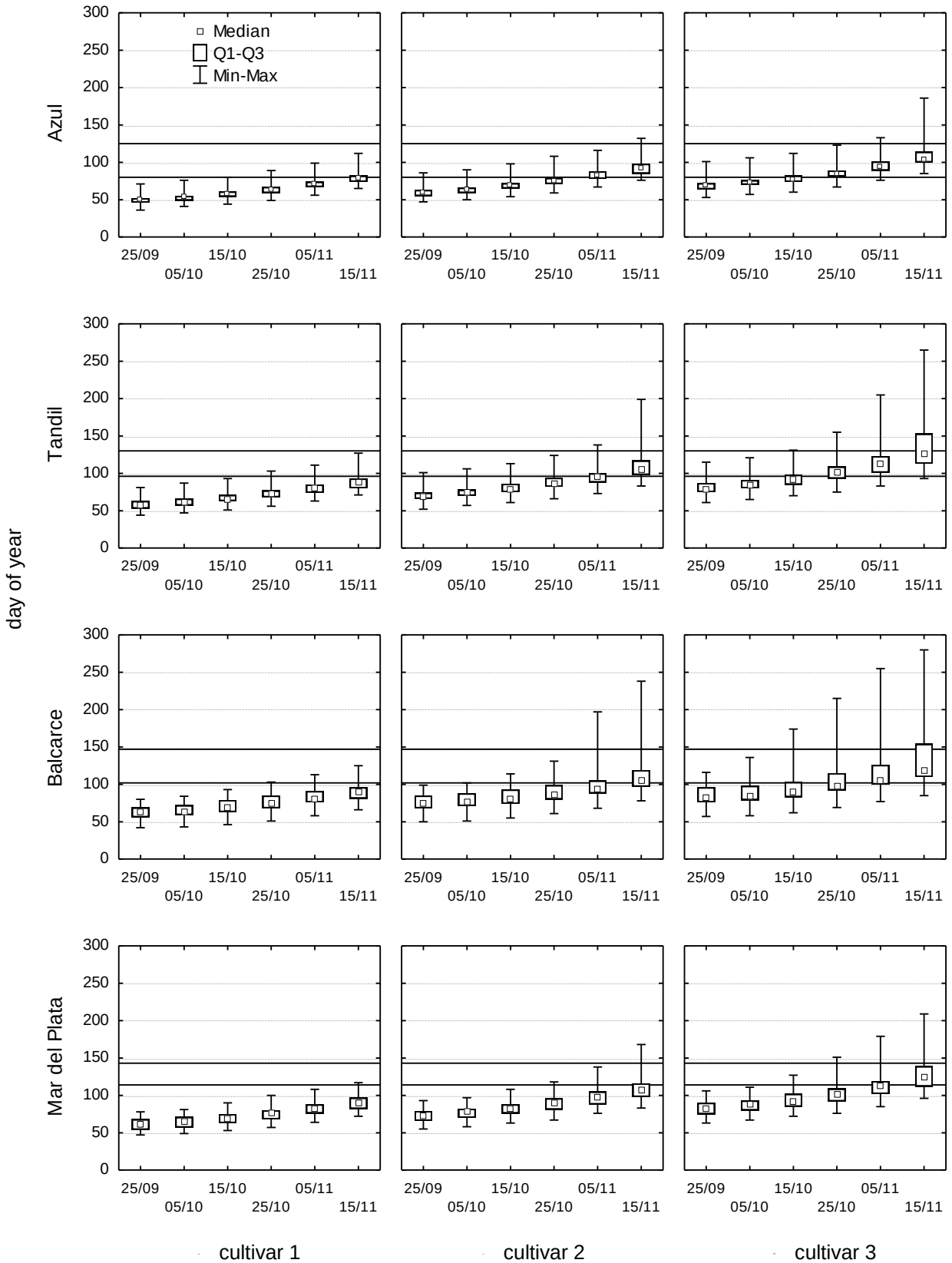


Figure 2 – Box-plots of predicted dates of occurrence of physiological maturity grouped by planting date and categorized by cultivar and location. Solid lines indicate the occurrence of media and extreme early meteorological frosts.

The number of years with frosts after V4 stage and before maturity for each cultivar was evaluated. For short season cultivar, relative frequency of frosts after V4 from planting on mid-October to early-November did not vary at each location (Figure 3) and predicted risks on the early planting were acceptable. Intermediate maturity cultivars had more risks on the latest planting dates (Figure 4). Therefore, the most advisable planting dates are between mid-October to late-October. Late planting should be avoided for cultivar 3 (Figure 5). No significant trends were detected for dates of occurrence of V4 stage of each cultivar across the evaluated planting dates, except at Balcarce with a trend to accelerate the occurrence of this stage. For the occurrence of R6 stage not significant trend has been reported (PANUNZIO MOSCOSO et al., 2013). Significant trend to occur earlier late frosts were detected at Balcarce. Moreover, Azul and Tandil showed trends to earlier occurrence of the autumn frosts.

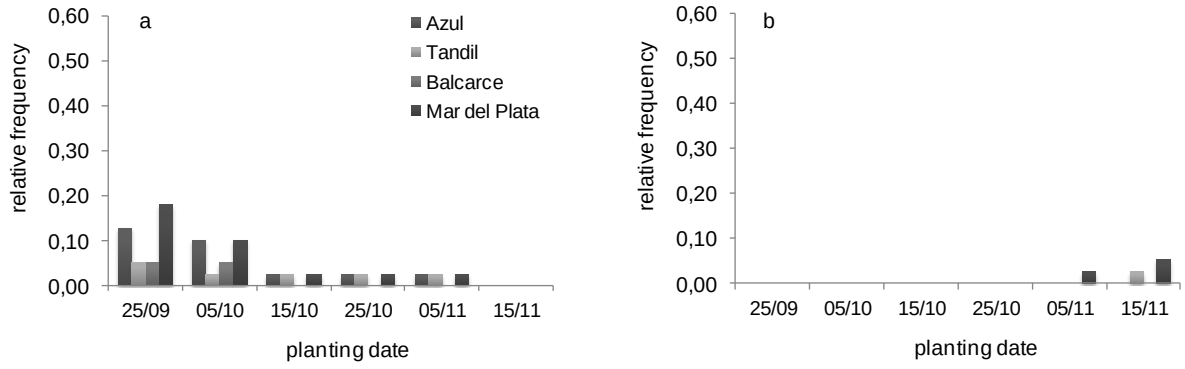


Figure 3 - Relative frequency of occurrence of years with meteorological frosts (series 1971-2010) according planting date and location for short season cultivar. a. after four developed leaves stage (V4). b. before physiological maturity stage (R6).

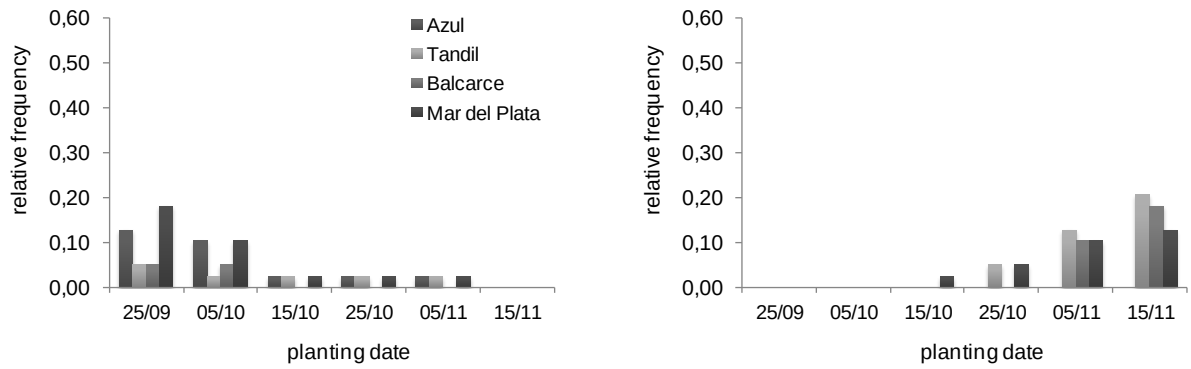


Figure 4 - Relative frequency of occurrence of years with meteorological frosts (series 1971-2010) according planting date and location for intermediate season cultivar. a. after four developed leaves stage (V4). b. before physiological maturity stage (R6).

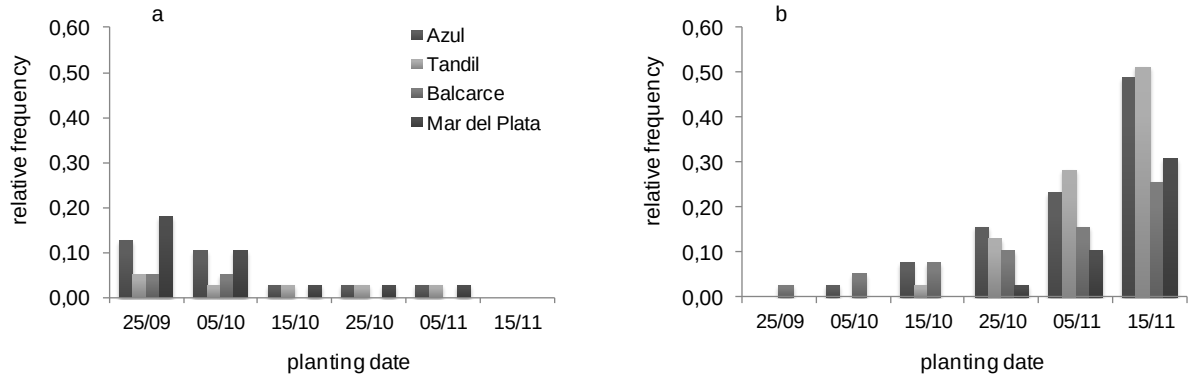


Figure 5 - Relative frequency of occurrence of years with meteorological frosts (series 1971-2010) according planting date and location for long season cultivar. a. after four developed leaves stage (V4). b. before physiological maturity stage (R6).

CONCLUSIONS

The best planting date for cultivars of contrasting maturity can be selected from predicted phenology and the climatology of late and early frosts. Risks on early stages are moderated. The high probability of frost occurrence before maturity indicated that late plantings for long season cultivars should be avoided at all locations. The use of short maturing cultivars can minimize this risk. Further studies on options of agricultural practices for climate variability and climate change must be linked to other environmental conditions as soil water availability. Significant trend to earlier occurrence of late frosts were detected at Balcarce. Moreover, Azul and Tandil showed trends to earlier occurrence of the autumn ones.

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