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Modeling phenological responses of table grape cultivars

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Introduction

Bud burst, blooming, berry set, veraison and harvest are the key phenological stages of grapevine and identification of these stages is of great economic value to enhance productivity by forecasting the effects of seasonal variations and timely vintage management. Crop modeling is a reliable and robust approach in assessing phenology, crop growth and yield. Chakwal and Rawalpindi/Islamabad districts are emerging as new clusters for commercial viticulture in Pothwar region of Pakistan where key phenological stages and physiological responses need to be identified. Therefore, the present study is designed to evaluate the pheno-physiological responses of table grape cultivars; Kings Ruby, Sugraone, Perlette, and NARC Black at Chakwal and Islamabad using Growing Degree Days (GDD) and STICS dynamic crop models.

Materials and Methods

Phenological observations were made at two locations i.e. Islamabad (Sub-humid) and Chakwal (Semi-arid) with varying pedo-climatic conditions (see figure) in pothwar region in four table grape cultivars; Kings Ruby, Perlette, NARC Black Sugra One. Nine vines of uniform vigor trained on vertical positioning system (I Trellis system) with age 4-6 years were selected for recording observations. Phenology and growth data were recorded on weekly basis but at some stages such as bud burst, blooming and berry set frequent observations were made at both locations, some times even same day for better phenology projection. Initial soil conditions were determined and on site weather data collected while missing data were obtained from Pakistan Metrological Department.

Results and Discussion

The results show that there exists wide variability in the phenological timing of table grape cultivars. All the phenological stages i.e. bud burst, 5 leaf stage, start of bloom, full bloom, veraison and harvest reached earlier in Chakwal in comparison with Islamabad. Perlette and NARC Black have more variation in their timing of veraison and maturity at both locations. Full bloom stage was attained earlier in cv. NARC Black as it took 21 and 24 days, while cv. Sugra One took 38 and 41 days to attain this stage at Chakwal and Islamabad respectively. Days to reach maturity from bud burst were more in cv. Sugra One as it took 112 and 118 days at Chakwal and Islamabad respectively. It is obvious that phenology is driven by temperature and phenological stages reach earlier in Chakwal with 1°C -1.5°C higher temperature than Islamabad where phenological stages arrive later due to less heat unit accumulation. Bud burst is 3-4 days earlier while flowering is 6-7 days earlier in semi-arid conditions of Chakwal. Varietal heat requirements to switch to next phenophase also vary at different phenological stages.

Conclusion

There exist a variation of phenological responses due to temperature fluctuations at both experimental vineyards. Varieties also have differences in phenological timings due to variation in heat unit requirements of different cultivars. The findings of the present research are useful in developing a grapevine phenological model for eco-friendly, resilient and precision viticulture in this emerging region by predicting key phenological events.

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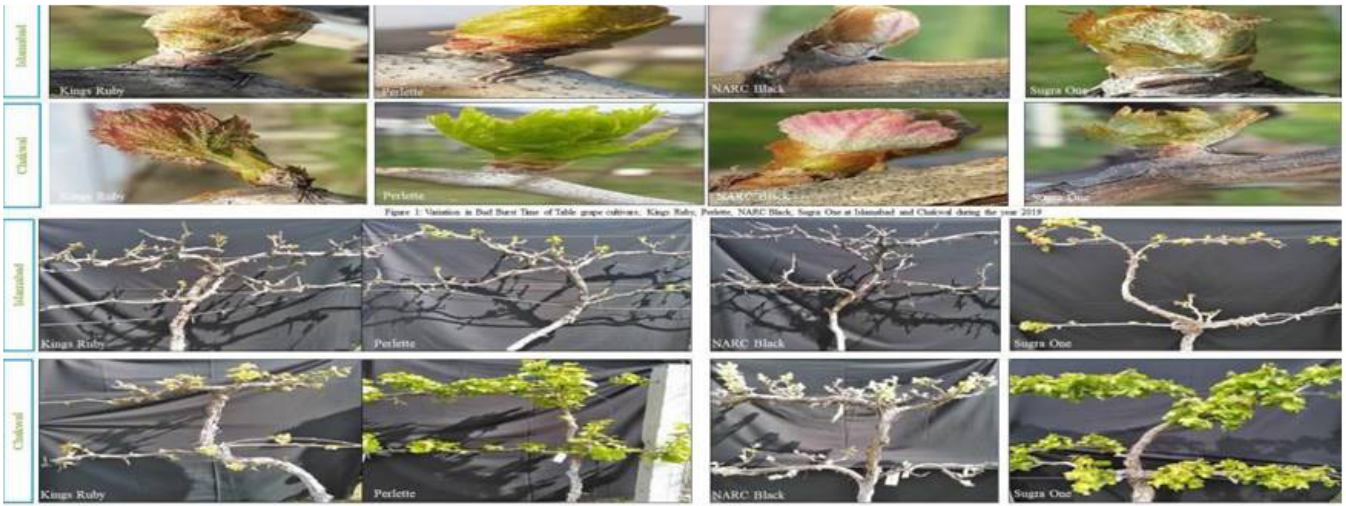
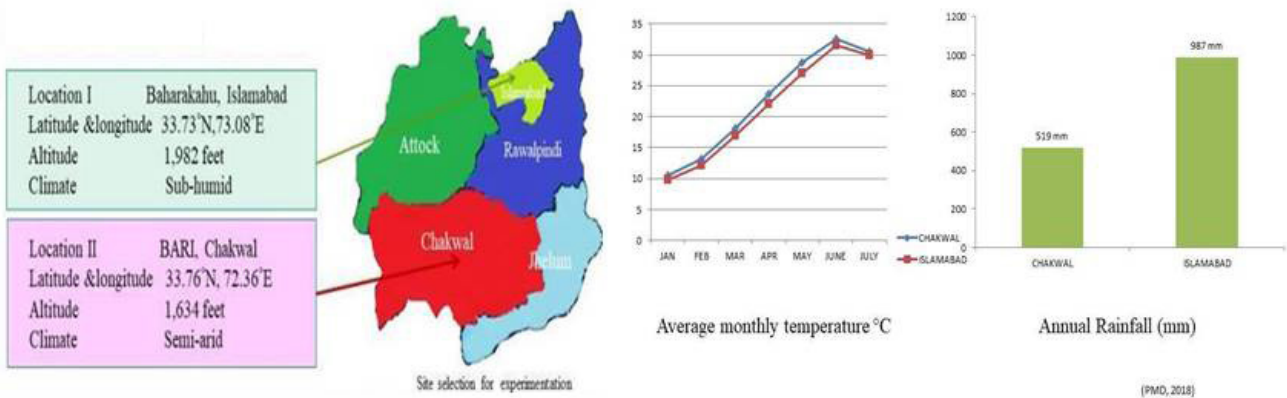


Figure: Vineyard locations, Variation in climatic conditions and phenological differences among varieties at both locations.

Keywords: Modeling, phenology, viticulture, GDD, Pothwar region.

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