Communication

The Influence of Variety and Climatic Year on the Phenology of Blueberry Grown in the Banat Area, Romania

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Abstract: This paper’s aim was to investigate the influence of variety and the climatic year on vegetation phenophases in blueberries grown in southwest Romania, the Banat region. This study was carried out during the growing season of 2020–2022 in a blueberry plantation, for ‘Duke’, ‘Hannah’s Choice’ and ‘Elliott’ varieties. In the study, phenological traits were recorded using the BBCH phenological scale and the observation of phenotypic data was recorded as in Julian days. Thus, it is found that the duration of each phenophase characterized each variety. The calendar periods for the onset of vegetation and the duration of spring phenological development stages in varieties have differed from year to year and depended on weather conditions. In the case of the phenological stage, depending on variety, the maximum amplitude was recorded for BBCH 87 stage (75% blue fruits) of 51 days, and the minimum amplitude, of 25 days, for BBCH 51 stage (bud swell) and BBCH 59 (late pink bud). The coefficient of variation, depending on climatic year, for generative phenophases, had values between 6.5% (BBCH 67-petal fall) and 21.1% (BBCH 51-bud swell). It was found that the variety and the climatic year influence the development of vegetation phenophases. The results indicate that blueberry cultivars have demonstrated a high degree of phenotypic plasticity to respond to gradual changes in environmental conditions and are important for the evaluation of cultivar cultivation prospects in the studied area.

Keywords: ANOVA; BBCH; phenophases; Julian day; Vaccinium corymbosum

1. Introduction

A major aspect in assuring successful blueberry cultivation and good productivity is the knowledge of the cycle of growth and fruiting and of the biology of the plant and how it adapts to the environmental conditions existing in different cultivation regions, with influence on the total income. Considering these aspects, it is important to monitor and forecast plant phenology. Additionally, considering that blueberry varieties are partially self-sterile, it is important to find varieties that bloom simultaneously in the same plantation, in order to obtain cross-pollination that leads to the binding of a large number of fruits and implicitly to a large increase in crops [1]. This aspect is one of the most important reasons for knowing the phenology of each variety cultivated in each plantation. Abiotic factors, especially temperature and humidity, do influence the date on which different phenophases appear and their duration, for example: bud swelling (bursting), flowering, fruit ripening and leaf fall [2–4]. Monitoring these environmental factors can be particularly important for farmers who want to introduce management practices at various stages of crop development. Diez-Rodriguez et al. [5] consider that the knowledge of the entomofauna associated with the blueberry, together with the similarity of composition with the phenological stages and the evaluated sites, contributes to the development of integrated...
pest management and the establishment of a crop production system. Additionally, for studying the impact of climate change on plants, researchers have used phenology as a particularly important tool, especially in troubled ecosystems [6]. The variations that appear from one year to another in the occurrence and duration of phenological stages can be used as a biological indicator in the ecology of various species, as their response to the climatic variations that occur [7]. Blueberry culture is of increasing interest due to the nutritional qualities of fruits and the therapeutic virtues of both fruits and leaves [8–10]. In general, the characteristics of a cultivar are defined by the environmental conditions in which it was obtained, but which may be quite different from those of the production area [11]. Taking into account the fact that the global environment is changing, with higher global temperature and extreme precipitation fluctuations, it is very important for farmers to know the adaptation of genotypes to different crop areas [12–16], as it is known that environmental factors require different development of vegetation phenophases [7,17,18]. The study of growth and development patterns of blueberry cultivars introduced under new environmental conditions is of great importance for evaluating their prospects because the rate of plant development has changed as a result of the spread of each species in different climatic and ecological conditions. Data on newly introduced blueberry cultivars for Central and Eastern Europe are fragmented and adapted to different climatic conditions [19,20] which differ significantly from the meteorological and climatic conditions in Romania. In many growing areas, blueberries are affected by late hoar frost and spring frosts. Thus, a means of reducing crop losses caused by frost damage would have an immediate economic impact, and as a result, studies are needed on the development of spring phenophases. The identification of cultivars adapted to the different cultivation areas in Romania will also trigger the expansion of blueberry cultivation. The objective of this was to evaluate the influence of the variety and the climatic year on the spring-summer phenophases of blueberries grown in southwestern Romania, the Banat region.

2. Materials and Methods

Experimental site and plant material. The experiment was organized in Ghereniș town (45°25′48″ N 21°34′55″ E), Caraș-Severin County, Banat region, located in the southwest of Romania, in a plantation established in 2015 (Figure 1). The culture system is super intensive, and the density is 4700 bushes per surface unit. The planting was done on bins covered with black agrotextile-type foil, and the planting distance is 3 × 0.7 m. Due to its location in the southwestern part of Romania, not far from the Adriatic Sea and sheltered by the Carpathians, the Caraș-Severin area has a moderate temperate-continental climate, with sub-Mediterranean nuances. During the research period, in the experimental plantation, the average annual temperature was 12.3 °C, while the average temperature in July was 22.5 °C, and in January it was 0.9 °C; the sum of annual rainfall was 828 mm. The soil has a medium clay-clay texture, with a clay content between 35–45% and a humus content between 2.3–2.7%.

Figure 1. Experimental site (Ghereniș town; 45°25′48″ N 21°34′55″ E, Caraș-Severin County).

The study was carried out over the period 2020–2022 on ‘Duke’, ‘Hannah’s Choice’ and ‘Elliott’ varieties.

Methods. The phenology of varieties was monitored according to BBCH (Biologische Bundesanstalt, Bundessortenamt und CHEmosche Industrie) scale, according to those described by Longstroth [21]. For the experiment, 30 shrubs were marked, in three repetitions
The study was carried out over the period 2020–2022 on ‘Duke’, ‘Hannah’s Choice’, and ‘Elliot’ blueberry varieties (Table 1) and the climatic conditions of the Banat area in Romania during 2020–2022. It can be seen that, according to the minimum number of days required for the development of phenophases, the ‘Elliot’ variety was the latest in the assortment, followed by ‘Duke’ and ‘Hannah’s Choice’, which highlights the influence of variety on the development of phenophases. The flowering phenology has shown that the varieties studied are different in regard to the start of vegetation, flowering moments and ripening of fruits [22]. Additionally, Kirk & Isaacs [23] suggest that flowering phenology of highbush blueberries differs significantly by variety and is predictable based on air temperature. In the case of the phenological stage, depending on variety, the maximum amplitude was recorded for BBCH 87 stage (75% blue fruits) of 51 days, and the minimum amplitude, of 25 days, for BBCH 51 stage (bud swell) and BBCH 59 (late pink bud). From the analysis of maximum and minimum phenophase development data, it appears that the first phenophases (BBCH 51-BBCH 67) unfold much more grouped (the amplitude depending on variety is between 25 and 31 days), while for the late phenophases, the amplitude was much longer, between 44 and 51 days.

The coefficient of variation, for the studied generative phenophases, had values below 15%, highlighting the stability of conditions of growth and development. It can be considered that blueberry population in the study is homogeneous, the phenological stages are quite grouped in the analysed variety, only for the BBCH 51 stage, in the ‘Hannah’s Choice’ which highlights the influence of variety on the development of phenophases. The flowering phenology has shown that the varieties studied are different in regard to the start of vegetation, flowering moments and ripening of fruits [22]. Additionally, Kirk & Isaacs [23] suggest that flowering phenology of highbush blueberries differs significantly by variety and is predictable based on air temperature. In the case of the phenological stage, depending on variety, the maximum amplitude was recorded for BBCH 87 stage (75% blue fruits) of 51 days, and the minimum amplitude, of 25 days, for BBCH 51 stage (bud swell) and BBCH 59 (late pink bud). From the analysis of maximum and minimum phenophase development data, it appears that the first phenophases (BBCH 51-BBCH 67) unfold much more grouped (the amplitude depending on variety is between 25 and 31 days), while for the late phenophases, the amplitude was much longer, between 44 and 51 days.

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Choice' variety, the values were higher (14.9%) (Table 1). It is found that the duration of each phenophase has characterized each variety. Thus, the results obtained in the field trials indicate that the length of the period from the bud swells (BBCH 51) to 75 blue (BBCH 87) of highbush blueberry varied from 180.6 to 222.3 Julian days (Table 1). In the case of the study carried out, the earliest phenophases were recorded in the 'Hannah’s Choice' variety, especially for the early phenophases (BBCH 51–81), so that the colouration of fruits started earlier in the ‘Duke’ variety (BBCH 83–87). The beginning of flowering is a very important parameter because of the possible damage to flowers by late spring frost [24], and the duration of phenological stages was influenced by the microclimate [25].

Table 1. Descriptive statistics regarding the influence of variety on generative phenophases of blueberries grown in the low hilly area of Banat (2020–2022).

| Phenophase         | Variety        | Mean  | SD    | CV (%) | Shapiro–Wilk | p-Value | Minimum | Maximum |
|--------------------|----------------|-------|-------|--------|--------------|---------|---------|---------|
| BBCH 51 (Bud swell)| ‘Duke’         | 52.0  | 3.66  | 6.9    | 0.942        | 0.537   | 49      | 56      |
|                    | ‘Elliott’      | 62.0  | 2.00  | 3.2    | 1.000        | 1.000   | 60      | 64      |
|                    | ‘Hannah’s Choice’ | 44.6  | 6.65  | 14.9   | 0.953        | 0.583   | 39      | 52      |
| BBCH 57 (Early pink bud) | ‘Duke’      | 99.3  | 2.08  | 2.1    | 0.923        | 0.463   | 97      | 101     |
|                    | ‘Elliott’      | 111.3 | 5.50  | 4.9    | 0.997        | 0.900   | 106     | 117     |
|                    | ‘Hannah’s Choice’ | 85.3  | 4.72  | 5.5    | 0.907        | 0.407   | 80      | 89      |
| BBCH 59 (Late pink bud) | ‘Duke’      | 106.6 | 4.93  | 4.6    | 0.832        | 0.194   | 101     | 110     |
|                    | ‘Elliott’      | 118.0 | 2.64  | 2.2    | 0.893        | 0.363   | 116     | 121     |
|                    | ‘Hannah’s Choice’ | 97.6  | 1.52  | 1.6    | 0.964        | 0.637   | 96      | 99      |
| BBCH 61 (Early bloom) | ‘Duke’       | 113.0 | 5.29  | 4.7    | 0.893        | 0.363   | 107     | 117     |
|                    | ‘Elliott’      | 123.6 | 3.78  | 3.1    | 0.855        | 0.253   | 121     | 128     |
|                    | ‘Hannah’s Choice’ | 103.6 | 5.13  | 5.0    | 0.949        | 0.567   | 98      | 108     |
| BBCH 67 (Petal fall) | ‘Duke’       | 127.00| 6.08  | 4.8    | 0.818        | 0.157   | 120     | 131     |
|                    | ‘Elliott’      | 142.3 | 4.04  | 2.8    | 0.750        | <0.001  | 140     | 147     |
|                    | ‘Hannah’s Choice’ | 121.3 | 4.72  | 3.9    | 0.907        | 0.407   | 116     | 125     |
| BBCH 71 (Early green fruit) | ‘Duke’     | 133.3 | 6.42  | 4.8    | 0.871        | 0.298   | 126     | 138     |
|                    | ‘Elliott’      | 155.3 | 10.40 | 6.7    | 0.923        | 0.463   | 147     | 167     |
|                    | ‘Hannah’s Choice’ | 128.6 | 6.68  | 5.2    | 0.953        | 0.583   | 123     | 136     |
| BBCH 81 (Fruit colouring) | ‘Duke’     | 155.0 | 8.71  | 5.6    | 0.842        | 0.220   | 145     | 161     |
|                    | ‘Elliott’      | 178.0 | 9.84  | 5.5    | 0.930        | 0.490   | 167     | 186     |
|                    | ‘Hannah’s Choice’ | 147.3 | 11.84 | 8.0    | 0.786        | 0.081   | 140     | 161     |
| BBCH 83 (10% Blue) | ‘Duke’        | 160.3 | 8.08  | 5.0    | 0.750        | <0.001  | 151     | 165     |
|                    | ‘Elliott’      | 192.6 | 1.52  | 0.8    | 0.964        | 0.637   | 191     | 194     |
|                    | ‘Hannah’s Choice’ | 162.6 | 5.50  | 3.4    | 0.997        | 0.900   | 157     | 168     |
| BBCH 87 (75% Blue) | ‘Duke’        | 180.6 | 4.50  | 2.5    | 0.996        | 0.878   | 176     | 185     |
|                    | ‘Elliott’      | 222.3 | 4.50  | 2.0    | 0.996        | 0.878   | 218     | 227     |
|                    | ‘Hannah’s Choice’ | 182.3 | 6.50  | 3.6    | 0.998        | 0.915   | 176     | 189     |

SD = standard deviation; CV = coefficient of variation.

The beginning of flowering (BBCH 61) occurred at 103.6 Julian days for the ‘Hannah’s Choice’ variety, and 123.6 Julian days for the ‘Elliott’ variety. The difference between the beginning of the vegetation period and the start of flowering was from 59 to 61.6 days. The flowering period (BBCH 61–67) occurred at 103.6–121.3 Julian days. The beginning of fruit ripening (BBCH 83) started on the 47th day after the beginning of flowering for the ‘Duke’
variety, and on the 69th day for the ‘Elliott’ variety. A duration of 41–51 days between the beginning of flowering and the beginning of fruit ripening was found by Sterne and Liepniece [24] in some highbush blueberry cultivars in Latvia. The time of fruit ripening (BBCH 81–87) fluctuated from 147.3 to 222.3 Julian days; the longest fruit ripening period was observed in the ‘Elliott’ variety at 44 days.

Table 2. Descriptive statistics regarding the influence of experimental year on generative phenophases of blueberry cultivated in the low hilly area of Banat (2020–2022).

| Phenophase          | Year | Mean  | SD    | CV (%) | Shapiro–Wilk p-Value | Minimum | Maximum |
|---------------------|------|-------|-------|--------|---------------------|---------|---------|
| BBCH 51 (Bud swell)| 2020 | 56.6  | 5.03  | 8.9    | 0.987               | 52      | 62      |
|                     | 2021 | 50.0  | 10.53 | 21.1   | 0.993               | 39      | 60      |
|                     | 2022 | 52.0  | 10.81 | 20.8   | 0.942               | 43      | 64      |
| BBCH 57 (Early pink bud)| 2020 | 96.0  | 15.52 | 16.2   | 0.997               | 80      | 111     |
|                     | 2021 | 101.3 | 15.04 | 14.8   | 0.994               | 87      | 117     |
|                     | 2022 | 98.6  | 8.73  | 8.9    | 0.947               | 89      | 106     |
| BBCH 59 (Late pink bud)| 2020 | 104.6 | 10.97 | 10.5   | 0.916               | 96      | 117     |
|                     | 2021 | 109.6 | 11.01 | 10.0   | 0.997               | 99      | 121     |
|                     | 2022 | 108.0 | 9.16  | 8.5    | 0.964               | 98      | 116     |
| BBCH 61 (Early bloom)| 2020 | 109.0 | 12.12 | 11.1   | 0.980               | 98      | 122     |
|                     | 2021 | 117.0 | 10.14 | 8.7    | 0.971               | 108     | 128     |
|                     | 2022 | 114.3 | 8.32  | 7.3    | 0.923               | 105     | 121     |
| BBCH 67 (Petal fall)| 2020 | 125.3 | 12.85 | 10.3   | 0.871               | 116     | 140     |
|                     | 2021 | 131.3 | 8.50  | 6.5    | 0.999               | 123     | 140     |
|                     | 2022 | 134.0 | 11.53 | 8.6    | 0.910               | 125     | 147     |
| BBCH 71 (Early green fruit)| 2020 | 132.0 | 13.07 | 9.9    | 0.842               | 123     | 147     |
|                     | 2021 | 139.0 | 12.53 | 9.0    | 0.995               | 127     | 152     |
|                     | 2022 | 146.3 | 17.89 | 12.2   | 0.750               | <0.001  | 136     | 167     |
| BBCH 81 (Fruit colouring)| 2020 | 151.0 | 14.00 | 9.3    | 0.862               | 141     | 167     |
|                     | 2021 | 160.6 | 20.50 | 12.8   | 1.000               | 140     | 181     |
|                     | 2022 | 168.6 | 15.04 | 9.9    | 0.805               | 159     | 186     |
| BBCH 83 (10% Blue)| 2020 | 166.3 | 21.57 | 13.0   | 0.860               | 151     | 191     |
|                     | 2021 | 173.6 | 16.77 | 9.7    | 0.800               | 163     | 193     |
|                     | 2022 | 175.6 | 15.94 | 9.1    | 0.827               | 165     | 194     |
| BBCH 87 (75% Blue)| 2020 | 192.0 | 22.71 | 11.8   | 0.855               | 176     | 218     |
|                     | 2021 | 193.0 | 25.23 | 13.1   | 0.830               | 176     | 222     |
|                     | 2022 | 200.3 | 23.18 | 11.6   | 0.821               | 185     | 227     |

A longer duration, 56–66 days, was found by Sterne and Liepniece [24] between the phenophase beginning of fruit ripening and full ripeness in ‘Jersey’ and ‘Bluecrop’ cultivars. Based on the Shapiro–Wilk test, it can be seen that, in general, the distribution of data regarding the generative phenophases is normal with a few exceptions, namely the phenophase BBCH 67 (petal fall) in the ‘Elliot’ variety and BBCH 87 (75% blue) in the ‘Duke’ variety (Shapiro–Wilk p-value < 0.001).

Regarding the influence of climatic year on the development of generative phenophases in the blueberries cultivated in the low hilly area of Banat, the results are presented in Table 2. It is found that the calendar periods for the beginning of vegetation and the dura-
tion of spring phenological development stages in the cultivars differ considerably from year to year and depend on weather conditions, a fact also supported by Sava et al. [26]. Additionally, Valdés et al. [27], in his study, shows that the phenology of flowering and fruiting was rather variable and clearly depends on temperature variations throughout the year. The relative values of bloom parameters determined here will also help managers plan their plantings of varieties that require crosspollination with compatible varieties. The flowering season, associated with chilling requirements, and harvesting season are important traits for the adaptation of the cultivars to different environments [12]. The coefficient of variation, depending on climatic year, for generative phenophases, had values between 6.5% (BBCH 67-petal fall, 2021) and 21.1% (BBCH 51-bud swell, 2021). In the case of the study carried out, in 2021, the earliest BBCH 51 phenophase was recorded, on average 50 days from 1 January. Depending on the evolution of environmental factors, the following phenophases unfolded differently, so that the earliness of 2021, from the BBCH 51 phenophase, was not preserved in the following phenophases. For fruit ripening, BBCH 81–87 phenophases occurred earlier in 2020, followed by 2021 and 2022 (Table 2): BBCH 81 (fruit colouring) at 151–192 Julian days; BBCH 83 (10% blue) at 166.3–175.6 Julian days; BBCH 87 (75% blue) at 192–200.3 Julian days. It was found that blueberry varieties demonstrated a high degree of phenotypic plasticity from one year to another. The conclusions are similar to those obtained by Drozd [28], who says that the rhythmic plasticity of blueberry varieties introduced in Belarus appeared in the ability to change the phenomenon due to different weather conditions during the years of observation and was reflected in the variation of the dates of the onset of the main phenological phases. Paulouski [29] considers that cultivation differences in blueberry development manifest themselves more vividly during the flowering period and especially during the fruit ripening stage. Regarding the influence of experimental year on generative phenophases of blueberries grown in the low hilly area of Banat, the distribution of data analysed from a statistical point of view is normal, with one exception, namely the BBCH 71 phenophase (early green fruit) in 2022, when the Shapiro–Wilk p-value < 0.001.

To determine whether the number of days required for each generative phenophase influences the duration of subsequent phenophases, Bravais-Pearson correlation coefficients (r calc) were calculated (Table 3).

Table 3. Matrix of correlations between BBCH generative phenophases in blueberries cultivated in the low hilly area of Banat.

| BBCH 51 | 57 | 59 | 61 | 67 | 71 | 81 | 83 | 87 |
|---------|----|----|----|----|----|----|----|----|
| 51      | 1  | 0.72** | 0.74** | 0.62*  | 0.68** | 0.69** | 0.67** | 0.65* | 0.77** |
| 57      | 1  | 0.96*** | 0.97*** | 0.85*** | 0.76** | 0.81*** | 0.78** | 0.77** |
| 59      | 1  | 0.98*** | 0.92*** | 0.84*** | 0.86*** | 0.85*** | 0.84*** |
| 61      | 1  | 0.91*** | 0.81*** | 0.83*** | 0.83*** | 0.78**   |
| 67      | 1  | 0.97*** | 0.94*** | 0.94*** | 0.94*** | 0.90***  |
| 71      | 1  | 0.97*** | 0.92*** | 0.92*** | 0.92*** | 0.90***  |
| 81      | 1  | 0.89*** | 0.90*** | 0.90*** | 0.90*** | 0.90***  |
| 83      | 1  | 0.97*** |

Pearson r calc value; df = 7 (two-tailed test); α = 0.05; n = 9; df = n − 2 two-tailed; p 0.1 = 0.582 *; p 0.05 = 0.666 **; p 0.01 = 0.798 ***.

The obtained results are presented in the matrix of correlations between BBCH generative phenophases in blueberries cultivated in the low hilly area of Banat. As can be seen from Table 3, all the phenophases correlate with each other, and in most cases, the distinctly significant correlations were calculated (r value ranged from 0.67 to 0.78) and, respectively, very significantly positive (r value ranged from 0.81 to 0.98). Regarding correlations, Baptista et al. [30] found that the flowering period was highly correlated with the
number of days to floral budbreak (r value ranged from 0.94 to 0.84), but not with floral budbreak-to-flowering interval. In other research, it has been observed that flowering time significantly correlates with harvest time in highbush blueberries [31,32]. In conclusion, we can state that these positive correlations obtained have highlighted the fact that with the increase in the number of days required for an early generative phenophase, there is generally an increase in the number of days required to reach the later phenophases in blueberries cultivated in the low hilly area of Banat.

ANOVA analysis was performed comparing between varieties and between years (Tables 4 and 5). It appears that the number of days required for the various phenophases is generally different between the cultivars compared, so it can be stated that they are genetically determined and differ by cultivar. This statement is supported by the statistical significance determined for each of the phenophases analysed, because in each of them there are significant differences between at least two of the three varieties compared to each other (Table 4). However, in the case of comparing the three experimental years, the identified situation is diametrically opposed. Thus, very high significance thresholds were obtained, which shows us that there are no significant differences between climatic years in any of the analysed blueberry phenophases (Table 5).

Table 4. Analysis of variance (ANOVA) on phenology under cultivar influence.

| Phenophase                  | Compared Varieties | Mean Difference | SE | t     | Pukey |
|-----------------------------|--------------------|-----------------|----|-------|-------|
| BBCH 51 (Bud swell)         | ‘Duke’ ‘Elliott’   | −10.000         | 3.692 | −2.709 | 0.078 |
|                             | ‘Elliott’ ‘Hannah’s Choice’ | 7.333         | 3.692 | 1.986 | 0.196 |
|                             | ‘Hannah’s Choice’  | 17.333          | 3.692 | 4.695  | 0.008 ** |
| BBCH 57 (Early pink bud)    | ‘Duke’ ‘Elliott’   | −12.000         | 3.559 | −3.372 | 0.035 * |
|                             | ‘Elliott’ ‘Hannah’s Choice’ | 14.000       | 3.559 | 3.934  | 0.018 * |
|                             | ‘Hannah’s Choice’  | 26.000          | 3.559 | 7.305 <0.001 *** |
| BBCH 59 (Late pink bud)     | ‘Duke’ ‘Elliott’   | −11.333         | 2.735 | −4.143 | 0.014 * |
|                             | ‘Elliott’ ‘Hannah’s Choice’ | 9.000        | 2.735 | 3.290  | 0.038 * |
|                             | ‘Hannah’s Choice’  | 20.333          | 2.735 | 7.434 <0.001 *** |
| BBCH 61 (Early bloom)       | ‘Duke’ ‘Elliott’   | −10.667         | 3.906 | −2.731 | 0.076 |
|                             | ‘Elliott’ ‘Hannah’s Choice’ | 9.333        | 3.906 | 2.889  | 0.118 |
|                             | ‘Hannah’s Choice’  | 20.000          | 3.906 | 5.120  | 0.005 ** |
| BBCH 67 (Petal fall)        | ‘Duke’ ‘Elliott’   | −15.333         | 4.101 | −3.739 | 0.022 * |
|                             | ‘Elliott’ ‘Hannah’s Choice’ | 5.667        | 4.101 | 1.382  | 0.407 |
|                             | ‘Hannah’s Choice’  | 21.000          | 4.101 | 5.121  | 0.005 ** |
| BBCH 71 (Early green fruit) | ‘Duke’ ‘Elliott’   | −22.000         | 6.566 | −3.351 | 0.035 * |
|                             | ‘Elliott’ ‘Hannah’s Choice’ | 4.667       | 6.566 | 0.711  | 0.766 |
|                             | ‘Hannah’s Choice’  | 26.667          | 6.566 | 4.061  | 0.016 * |
| BBCH 81 (Fruit colouring)   | ‘Duke’ ‘Elliott’   | −23.000         | 8.344 | −2.756 | 0.074 |
|                             | ‘Elliott’ ‘Hannah’s Choice’ | 7.667        | 8.344 | 0.919  | 0.649 |
|                             | ‘Hannah’s Choice’  | 30.667          | 8.344 | 3.675  | 0.024 * |
| BBCH 83 (10% Blue)          | ‘Duke’ ‘Elliott’   | −32.333         | 4.667 | −6.929 | 0.001 ** |
|                             | ‘Elliott’ ‘Hannah’s Choice’ | −2.333      | 4.667 | −0.500 | 0.874 |
|                             | ‘Hannah’s Choice’  | 30.000          | 4.667 | 6.429  | 0.002 ** |
| BBCH 87 (75% Blue)          | ‘Duke’ ‘Elliott’   | −41.667         | 4.295 | −9.702 <0.001 *** |
|                             | ‘Elliott’ ‘Hannah’s Choice’ | −1.667       | 4.295 | 0.388  | 0.921 |
|                             | ‘Hannah’s Choice’  | 40.000          | 4.295 | 9.314 <0.001 *** |

Note. p-value adjusted for comparing a family of 3; * p < 0.05, ** p < 0.01, *** p < 0.001.

From a practical point of view, these results can also be used in the zoning of blueberry varieties according to climatic characteristics, since climate change affects blueberry culture [33–35]. For example, the fewer the days the early generative phenophases need to manifest, the shorter the time to obtain the first blueberry harvest, and vice versa, i.e., if the first generative phenophases require a higher number of days, it is possible that the
formation of actual fruit production will be delayed, this being susceptible to being affected, for example, by high temperatures in summer [36].

### Table 5. Analysis of variance (ANOVA) on phenology under the influence of year.

| Phenophase               | Compared Years | Mean Difference | SE  | t     | P<sub>tukey</sub> |
|--------------------------|----------------|-----------------|-----|-------|-------------------|
| **BBCH 51 (Bud swell)**  | 2020 2021      | 6.667           | 7.503 | 0.889 | 0.667             |
|                          | 2020 2022      | 4.667           | 7.503 | 0.622 | 0.814             |
|                          | 2021 2022      | −2.000          | 7.503 | −0.267| 0.962             |
| **BBCH 57 (Early pink bud)** | 2020 2021      | −5.333          | 10.992| −0.485| 0.881             |
|                          | 2020 2022      | −2.667          | 10.992| −0.243| 0.968             |
|                          | 2021 2022      | 2.667           | 10.992| 0.243 | 0.968             |
| **BBCH 59 (Late pink bud)** | 2020 2021      | −5.000          | 8.507 | −0.588| 0.832             |
|                          | 2020 2022      | −3.333          | 8.507 | −0.392| 0.920             |
|                          | 2021 2022      | 1.667           | 8.507 | 0.196 | 0.979             |
| **BBCH 61 (Early bloom)** | 2020 2021      | −8.000          | 8.424 | −0.950| 0.632             |
|                          | 2020 2022      | −5.333          | 8.424 | −0.633| 0.808             |
|                          | 2021 2022      | 2.667           | 8.424 | 0.317 | 0.947             |
| **BBCH 67 (Petal fall)** | 2020 2021      | −6.000          | 9.076 | −0.661| 0.793             |
|                          | 2020 2022      | −8.667          | 9.076 | −0.955| 0.629             |
|                          | 2021 2022      | −2.667          | 9.076 | −0.294| 0.954             |
| **BBCH 71 (Early green fruit)** | 2020 2021      | −7.000          | 12.003| −0.583| 0.834             |
|                          | 2020 2022      | −14.333         | 12.003| −1.194| 0.498             |
|                          | 2021 2022      | −7.333          | 12.003| −0.611| 0.820             |
| **BBCH 81 (Fruit colouring)** | 2020 2021      | −9.667          | 13.684| −0.706| 0.769             |
|                          | 2020 2022      | −17.667         | 13.684| −1.291| 0.450             |
|                          | 2021 2022      | −8.000          | 13.684| −0.585| 0.833             |
| **BBCH 83 (10% Blue)**  | 2020 2021      | −7.333          | 14.915| −0.492| 0.878             |
|                          | 2020 2022      | −9.333          | 14.915| −0.626| 0.812             |
|                          | 2021 2022      | −2.000          | 14.915| −0.134| 0.990             |
| **BBCH 87 (75% Blue)**  | 2020 2021      | −1.000          | 19.381| −0.052| 0.999             |
|                          | 2020 2022      | −8.333          | 19.381| −0.430| 0.905             |
|                          | 2021 2022      | −7.333          | 19.381| −0.378| 0.925             |

### 4. Conclusions

It was found that the variety and the climatic year do influence the development of vegetation phenophases. The differences in phenology recorded between varieties are caused by different accumulation of the amount of temperature necessary for the development of a certain phenophase and in correlation with the requirements of variety. The results indicate that blueberry varieties demonstrated a high degree of phenotypic plasticity to respond to gradual changes in environmental conditions.

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