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The articles appearing in this journal are indexed and abstracted in: EBSCO Publishing, Inc. and AGRIS (FAO).

The journal is accepted to be indexed with the support of a project № BG051PO001-3.3.05-0001 “Science and business” financed by Operational Programme “Human Resources Development” of EU. The title has been suggested to be included in SCOPUS (Elsevier) and Electronic Journals Submission Form (Thomson Reuters).

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Genetics and Breeding

Gene action in the inheritance of date to ear emergence and time to physiological maturity in bread wheat crosses (*Triticum aestivum* L.)

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¹Agronom I Holding, 9300 Dobrich, Bulgaria
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**Abstract.** The date of ear emergence (DEE) and the date (time) of physiological maturity (TPM), as quantitative indication affect yield and in this respect any information about their genetic nature is important for breeding in climatic anomalies of the country. This study aims to give a detailed analysis of the succession of traits DEE and TPM to gather updated information on the genetic control of contrast by combining traits varieties. We studied six generations originating from 6 hybrid combinations of “early” and “late” with respect to the varieties of both traits. It was determine the type of inheritance and coefficients of heritability. To identify real opportunities for breeding of early forms recurrent combinations with each of the parental varieties are made. Data suggest complex interactions between genes for both traits. An inspection for the presence of epistatia by applying the well-known 3-parameter test, is calculated. For additional information components of genetic diversity were calculated. In crosses in which is found non-allelic interaction is applied 6-parameter model, that explains the specific nature of these interactions on a cross. The combination of varieties with different dates of ear emergence and maturation succession of both traits is partially.

**Keywords:** winter wheat, gene action, inheritance, date of ear emergence, date of physiological maturity

**Abbreviations:** DEE – Date of ear emergence (heading), TPM – time to physiological maturity, \( H^p \) – coefficient of broad sense heritability, \( h^2 \) – coefficient of narrow sense heritability, \( P_1 \) – female parent, \( P_2 \) – male parent, BC – backcross generation

**Introduction**

Wheat grain feed humanity from antiquity to the present day. Wheat is the crop to be grown in a variety of environmental conditions, such as latitude and altitude. In turn, this affects the vegetation period, which according to widely cited study of Worland and Snape (2001), can last from 50 to 300 days. This duration is dictated by the combinations of different alleles of genes for vernalization and photoperiods (Snape et al., 2001). Winter-type wheat is characterized by significant demands on both, which is why it is a crop of microclimate. A staged development of it implies a great variability in the date of ripening and ear heading that, according to (Kobljiški et al., 2002) it is in the range of 20 – 25 days. Variation is reason to seek the optimal range of expression of two traits in specific conditions of the region or country (Boyadjieva, 2002; Mersinkov, 2005). Known genetic control of wheat can not explain many of the differences in the actual growing season of different varieties (http://www.shigen.nig.ac.jp/). Those who differ materially for date ear emergence and maturation have identical alleles of genes for vernalization and photoperiods (Tsenov, 2005; Zheleva et al., 2006). The discovery of the genes for “interior earliness”, \( \text{Eps} \), which are specific for each genotype. (Steimalkh, 1998; Bullrich et al., 2002; Zhang et al., 2009), complicates our understanding of inheritance of DEE. Complex and multi-layered genetic basis of precocity is why in recent years to pay less attention to the succession of the trait in breeding point of view (Tsenov, 2009).

There have been various types of genetic effects of genes, which further impedes breeding-genetic analysis of every trait (Tsenov, 2005b). In some crosses “earliness” may be transferred to hybrid conditions, such as latitude and altitude. In turn, this affects the combination. Besides direct genetic control of ear emergence date of interactions between different genetic systems of staged development (Vrn, Ppd), as temperature, humidity and light. This complicates the determination of the actual differences in varieties and may have obfuscated effect on genetic control of inheritance (Shindo et al., 2003; Yang et al., 2009) and further complicate the observed regularities.

The study of Nanda et al. (1981) the vegetation period may be shortened significantly if used recurrent breeding. This is possible provided that it is established the presence of non-allelic interaction of genes as is the case with spring wheat in India (Singh et al., 1987; Singh et al., 1988). No allelic interactions between genes are established with some other quantitative traits of wheat (Tsenov, 1995; Tsenov, 1996), were observed manifestations of heterosis or complete dominance. In studies of several characters in wheat Walla et al. (1994) and Akinci (2009) reported the occurrence of strong

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non-allelic interactions in their inheritance. When you find heterosis is the result of non-allelic interaction of dominant genes (Tsenov, 1990; Dobrotvorskaya and Martinov, 1990) success in the breeding is very slow and inefficient for any quantitative trait.

The purpose of this study was to analyze the genetic nature of inheritance of characters studied associated with the length of time to ear emergence and time physiological maturity, and to gather updated information on the genetic control of combining contrasting varieties on the grounds, in conjunction with manifestations of heterosis.

Material and methods

Two groups between crossbred varieties, which differ in the traits of the ear emergence date and the date of physiological maturity were studied. The first group includes cross combinations: 504-18/Kaloyan (1), Kaloyan/Obriy (2) and Pryaspa/Kaloyan (3) and there where selected varieties differ in varying degrees from one another in the two study characters. The second group of cross consists of a combination of three different early variety Galatea (4), Enola (5) and Iveta (6) component and fathers used the same advanced line 407-1 (Medea), and their difference with it is 6 to 9 days for date of the ear heading. Variety Kaloyan and line 504-18 (Zornita) were created in the 70s of the last century at the Institute by the breeders, Karaivanov and Dontcheva, respectively. Differences in their dates of ear emergence and physiological maturation were studied during the period 1990 – 1995, but the data have not been published. Newer varieties Galatea, Enola and Iveta and line 407-1 were obtained during the last years of the 20th century (Tsenov et al., 1999; Kostov et al., 1998; Tsenov et al., 2011). Variety Obrii (BGI, Odessa, Ukraine) was also studied mainly due to its high grain quality (Tsenov, 1995) and grain productivity. Inheritance of two traits that are presented as number of days from January 1 to respect date is analyzed. Determination of each date (the average value of each of them) is done in phases 55th and 94th, respectively, according to the scale of Zadoks et al. (1974). To pinpoint the average of two characters in hybrid generations 10 plants of recurrence for parents and F1 generations of simple crosses and after the backcross are marked. In F2 hybrid populations labeled plants are 50 of a repetition. Plants from all studied groups (F1, B1, B2, and F2) were grown in a randomized block of three repetitions in rows 1.5 m long at a distance between plants in rows of 0.20 m and 0.25 m between rows. Type of inheritance and coefficients of heritability in broad and narrow sense are calculated according to the formulas presented in Genchev et al. (1975). To identify real opportunities for breeding of earliness combinations with each of the parental varieties are re-saturated. The data obtained from different combinations suggest a complex interaction between genes for two traits. Whether there is a manifest of epistasis three-parameter test (Jinks and Perkins, 1970) by Singh (1981) is used. The presence of significantly different from zero in some parameters [A], [B] and [C] is an indication for the presence of interactions as epistasis for the inheritance. To identify the nature of the non-allelic interaction and 6-parameter model Hayman (1958) is attached. According to the methodology it determines the types of gene actions that affect the expression of as follows: [d]-additive, [h]-dominant, [i]-additive x additive, [j]-dominant x dominant and [l]-additive x dominant. The components of genetic diversity resulting from the additive effect of genes [D] or dominance [H] was defined by model of Mather and Jinks (1985), which provides additional information about the inheritance of trait in specific crosses. This model is applied to make a final assessment of the nature of gene action in established non-allelic interactions.

Results

The mean values of the trait in F1 in all hybrid combinations showed partial dominance of “late” parental component, except for only a cross 3 (Table 1). The variation of the trait in the simple combination of these is normal and generations move within 10 – 12 %, i.e., about 25 – 45 % less than the variation of the parents. The variation in F2 is significantly higher and is in the range of 15 % (5) and 24 % (6). Backcrossing with any of the two parent change means in the populations of F1 and F2. The direction of change is adequate to the parent – in early parent population mean change in the direction of its average value and vice versa.

The difference in the effect of the population with parent that is backcrossed is that in the “late” means showed complete dominance of “late” date of ear emergence (combinations 1, 3). Backcrossing in one of the parents increase the variation of the character, as in F2, is greater than F1, normally. It is noteworthy that backcross with “early” parent causes greater variation in both generations (F1, BCP, and F2, BCP) compared with the respective generations BCP. Such a change in the hybrid population is typical, when the share of genes with additive effect or recessive alleles in the direction of an earlier date of ear heading. Some evidence of this is the change in the population mean in that particular direction. Indeed the variation is about 2 – 3 % higher but in all populations, and should be recognized as a trend. Breeding of terms, we can say that this variation to some extent share of recombination in individual plants, which increases the chance of selection on date of ear heading or close to the level of “early” parent.

Both coefficients of heritability show patterns of inheritance, which are generally known (Tsenov, 2005b). Relatively high levels of H2 (0.66 – 0.82) are user interaction with the growing conditions in the 20 – 32% of the phenotypic variation of the trait. This is normal for those, given the highly variable values of the meteorological factors in the spring to ear emergence (Kazandjiev et al., 2011) and it is close to their impact on the components of grain productivity (Tsenov et al., 2013). According to the values of the coefficient h2 (0.30 – 0.46) additively acting genes have a share less than half on the variation of the trait. In a study of that trait, Shoran et al. (2003) reported that the length of the period to ear emergence and date of physiological maturation are mainly determined by genes with additive effect. When combining winter spring wheat Nanda et al. (1990) reported on additive-dominate genetic system for the period of ear heading. This, to some extent with evidence that the latest dates of ear emergence is determined by dominant genes, and early forms are identified by recessive genes (Tsenov, 2005a). Each individual cultivar has a variety of unique genes “intrinsic earliness” (Eps), which are not affected by growing conditions at all, and could suitably be used in breeding programs (van Beem et al., 2005). In addition to the established regularities are the data in Figure 1. It presents the type of inheritance of the trait represented by the parameter d/a. In the first three cross saturation of population with “late” parent causes heterosis (d/a > 1.0), which remains largely in two generations (F1, BCP, and F2, BCP.). Such heterosis is observed in a cross 6 but in the direction of the shorter time to ear heading. As a
rule, the means of all the $F_1$ generations is reduced to $F_2$. This is real evidence of manifestations of heterosis in the first generation, which in subsequent generations gradually subsides.

When the trait to physiological maturity (TPM) similar patterns were observed (Table 2). Here, the difference between varieties is greater as greater and their fluctuation. Most stable are

Table 1. Statistical data for trait time to ear emergence in investigated crosses

<table>
<thead>
<tr>
<th>Generation</th>
<th>Mean</th>
<th>CV%</th>
<th>$h^2$</th>
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Figure 1. Inheritance of date of ear emergence by the parameter d/a
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<td>20.3</td>
<td>0.78</td>
<td>0.40</td>
<td>6-F, BCP</td>
<td>173</td>
<td>21.2</td>
<td>0.81</td>
<td>0.47</td>
</tr>
<tr>
<td>3-F, BCP</td>
<td>174</td>
<td>18.9</td>
<td>0.84</td>
<td>0.38</td>
<td>6-F, BCP</td>
<td>175</td>
<td>18.4</td>
<td>0.87</td>
<td>0.48</td>
</tr>
<tr>
<td>3-F, BCP</td>
<td>174</td>
<td>23.3</td>
<td>0.83</td>
<td>0.30</td>
<td>6-F, BCP</td>
<td>174</td>
<td>23.3</td>
<td>0.85</td>
<td>0.46</td>
</tr>
<tr>
<td>P, Kaloyan</td>
<td>175</td>
<td>6.5</td>
<td></td>
<td></td>
<td>P, 407-1</td>
<td>177</td>
<td>7.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 2. Inheritance of date of physiological maturity by the parameter d/a

The varieties Obrii (4.5%) and Galateya (6.1%). In some of them with less difference in the trait expression variation in populations F2 BCP, is stronger than that of F3 BCP, and that is the substantial difference in TPM (crosses 3 and 6). Another important difference is that the values of the two coefficients of the inheritance have higher values. $H^2$ ranges 0.76 – 0.89 (TEE – 0.70), and $h^2$ indicates that the
addition of factors account for approximately 50% of the variation in the TPM, where in 33% of TEE. Cross 5 is dominated by lower values (0.34 to 0.39), which means a larger share of the dominant genes or more complex interaction between genetic systems of the two parental varieties.

Two of the crosses (2 and 5) backcrossing with "early" parent pulls the average of TPM strongly in his direction (Figure 2). This was also observed in the other crosses, but is significantly less. We observe partial dominance of earlier date of ear emergence. With this trait, the inheritance is different from the first (TEE), in which heterosis is presented. The interesting thing here in F, BCP, complete domination is obtained. Let us recall that the relationship between both traits is strong (Tsenov, 2009), but there is a genotypic specificity in the reaction conditions. This inevitably affects the hybrid populations, which are a collection of recombinant varieties. Another important difference from the TEE is less effect on the population mean, which is obtained by backcrossing with "late" parent. Instead heterosis (TEE), a partial dominance with d/a = 0.75 is observed. Much larger difference between the means of F, versus F, which is an indication of the expansion of the recombination in the direction of early heading.

**Discussion**

In combination 2 and 6 with participation of Obrii and Iveta varieties epistas is missing because the values of the three parameters of the test are not reliable (Table 3). For all other combinations non-allelic interactions between genetic factors influencing the expression of the trait are presented. Reliable effects additively acting genes occurred in combinations 1 and 4. However, if we compare their absolute values we will find the dominant genes dominate as effects in them. In practice, they were identified in all communication) and are considered very promising because good earliness like Enola already created (Tsenov, personal communication) and are considered very promising because good

The magnitude of the dominant effect is greater, in crosses in which the difference between the parents is less and vice versa. This is an indication of the dominant control on the later date of ear emergence. In combination with the participation of a variety Kaloyan (4 and 5) non-allelic interactions are of the type [l] which means dominant x dominant genes. This is the most complex possible interactions, which ultimately extends the period to the date of ear emergence of hybrid populations. In combination 1 exhibits a complex effect of additive x additive genes [l]. The same type of epistas and exist in combinations 4 and 5 involving Galatea and Enola, which are the earliest parent components. By connecting the inheritance of trait in them we find that the earlier date of ear heading (precocity) will hardly be transferred due to complexity of the effects of genes on them. Even after backcrossing with them, the mean of the populations can not reach close to their parental values (Table 1).

On the other hand, in combination with Kaloyan cultivar (1 and 3) observing the presence of a dominant gene effect, and with an additive x dominant [j]. The majority of plants in populations are late and early are marginal, making it difficult selection of early forms. In combination with a 504-18 there are genes with additive effect, which is an indication of the possibility of using this variety in the direction of shorter time to ear emergence. The interaction of factors in a cross with Enola 5 is different in kind from all other crosses - dominant [d] and additive x additive [i], without self action of additive factors. Comparison with the data in Table 1 shows the intermediate inheritance of the trait in F, and early ear heading of the variety is difficult to transfer, even after backcross with it (BCP).

Croses involving line 407-1 (4, 5 and 6) show the absence of non-allelic interaction of a type different from the additive x additive [l]. The publication of Tsenov (2005a) has concluded that 407-1 could be used in breeding, due to high SCA , but only provided that the other component is early one. Early wheat lines from a cross 5 with earliness like Enola already created (Tsenov, personal communication) and are considered very promising because good compromise combined with high grain yield. The estimated components of genetic variation with the intention to establish the majority of the reasons for the observed variation in the background

<table>
<thead>
<tr>
<th>Crosses</th>
<th>Component 1</th>
<th>Component 2</th>
<th>Component 3</th>
<th>Component 4</th>
<th>Component 5</th>
<th>Component 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2.22</td>
<td>3.03</td>
<td>2.95</td>
<td>3.42</td>
<td>4.33</td>
<td>3.89</td>
</tr>
<tr>
<td>B</td>
<td>3.28</td>
<td>3.67</td>
<td>4.11</td>
<td>4.08</td>
<td>4.87</td>
<td>3.57</td>
</tr>
<tr>
<td>C</td>
<td>2.14</td>
<td>2.26</td>
<td>2.01</td>
<td>2.44</td>
<td>2.54</td>
<td>2.01</td>
</tr>
<tr>
<td>D</td>
<td>1.55</td>
<td>1.14</td>
<td>1.25</td>
<td>1.27</td>
<td>1.48</td>
<td>1.51</td>
</tr>
</tbody>
</table>

Table 3. Scaling test for epistasis and estimates of gene effects for time to ear emergence of crosses studied

Table 4. Evaluation of the additive (D) and dominant (H) components of the time to ear emergence for every combination
of the complex allele and non-allelic interactions between genetic factors is presented in Table 4. Without exception, in all crosses the variation is due to the additive and dominant gene actions. The results fully confirm the opinion of Tsenov (2005b), whereby the inheritance of the trait date of ear heading at 6 hybrid combinations is due to additive – dominant genetic control. The trait is inherited primarily by the dominance of the late date of ear emergence, but evidence for this is only one case in which the additive component [D] is higher than the dominant [H], combination 6.

A clear evidence in support of this thesis are the low values of the component [F], which shows the low and in the case negligible proportion of genes in recessive state. Low values of the environmental component [E], are an indication of the genetic stability of the trait and little influence of the environment on its manifestation. This is because only two year period of the study. In a long-term study found a strong influence on the conditions of the season (Tsenov, 2009) and genotype-specific response of the variety to the active temperature sums during the active growing season.

When the trait time to physiological maturity of two hybrid combinations (3 and 5) no non-allelic interaction between the genes influencing there of (Table 5). These are crosses involving varieties Pryaspa 3 and Enola 5 as female parents. In other crosses were observed additive [d], dominant [h] and the interaction between them. In combinations 1 and 2 are very strong effects of additive x additive factors [j]. Therefore, in these two populations of hybrid selection in the direction of advance forms will be significantly more effective. We must not forget, however, significant effects that have a dominant force there genes (15.47) and (14.14), respectively. These values are signal of significant share in the total variation and behavior is in direct proportion to the difference in the genetics of the dominant force there genes (15.47) and (14.14), respectively. These direction of its values, but specific for each hybrid combination. This selection in the direction of advance forms will be significantly more tangible, the inheritance is approaching the mean parental level and additive factors [i]. Therefore, in these two populations of hybrid maturation. As the difference in traits between parents is more pronounced these are analogous to those for the time of ear emergence. Prevalence is the dominant ingredient in all combinations, without exception. In combination with the earliest varieties Obrii 2 and Galatea 4 observing the presence of the component due to the recessive genes (F=2.78*) and (F= 2.71*), respectively. There is also less of an impact on the environments of the season [E], in comparison with that of the trait date of the ear heading . Such variability indicates a linear variation of the values of character in the various populations. The lowest effect of conditions is in the said cross. In crosses involving 407-1 component of additive effects is higher than other crosses and combinations 4 and 6 is close in value to the dominant one.

Based on the analyzes in conclusion we can make a few generalizations. When combining varieties with significant differences in the level of one trait in populations to F 1 hybrid generation inheritance of the traits are similar. As a rule, in the population of plants to dominate later ear emergence and maturation. As the difference in traits between parents is more tangible, the inheritance is approaching the mean parental level and vice versa. The backcross with the parent changes population in the direction of its values, but specific for each hybrid combination. This behavior is in direct proportion to the difference in the genetics of the parents. These results fully confirm the findings in the publication of Tsenov and Tsenova (2011) made on the basis of research on the Combining Ability of group varieties on both grounds. Information from the study of Tsenov et al. (2013) that the varieties Pryaspa and Obrii have specific combining ability in general is confirmed here. In conjunction with their participation backcrossing with late parent for DEE das not have the same effect as other varieties, regardless of

### Table 5. Test for epistasis and estimates of gene effects for time to physiological maturity of studied crosses

<table>
<thead>
<tr>
<th>Cross</th>
<th>Component</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>m</th>
<th>d</th>
<th>h</th>
<th>i</th>
<th>j</th>
<th>l</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>-6.73±1.79**</td>
<td>-4.43±2.06**</td>
<td>-6.06±3.32**</td>
<td>168.6±2.78</td>
<td>27.46±3.91**</td>
<td>15.47±9.63**</td>
<td>-7.1±3.89**</td>
<td>-3.33±3.51</td>
<td>6.26±5.97</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>-3.59±1.63**</td>
<td>6.92±2.83**</td>
<td>6.65±3.10**</td>
<td>170.2±3.44</td>
<td>24.55±3.53**</td>
<td>14.14±8.64**</td>
<td>-7.51±2.31**</td>
<td>-4.3±3.61</td>
<td>4±5.34</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>0.43±1.83**</td>
<td>2.13±2.96**</td>
<td>-3.31±4.21**</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>-7.13±1.88**</td>
<td>-6.23±3.66**</td>
<td>-8.38±3.92**</td>
<td>168.6±2.78</td>
<td>27.46±3.91**</td>
<td>15.47±5.13**</td>
<td>-4.81±4.91</td>
<td>-3.03±4.01</td>
<td>10.02±4.71**</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>-3.54±3.74**</td>
<td>3.55±3.82**</td>
<td>4.65±5.51**</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

* – estimated value ± standard deviation

### Table 6. Evaluation of the additive (D) and dominant (H) components of the time to physiological maturity for every combination

<table>
<thead>
<tr>
<th>Component</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>2.77**</td>
<td>2.88**</td>
<td>3.22**</td>
<td>3.89**</td>
<td>3.68**</td>
<td>4.11**</td>
</tr>
<tr>
<td>H</td>
<td>3.55**</td>
<td>3.25**</td>
<td>3.44*</td>
<td>4.33**</td>
<td>4.75**</td>
<td>4.28**</td>
</tr>
<tr>
<td>F</td>
<td>2.75**</td>
<td>2.78**</td>
<td>2.92**</td>
<td>2.71**</td>
<td>2.18*</td>
<td>1.92*</td>
</tr>
<tr>
<td>E</td>
<td>1.14</td>
<td>1.15</td>
<td>1.04</td>
<td>1.12</td>
<td>1.25</td>
<td>1.17</td>
</tr>
</tbody>
</table>

16
the difference in their means, as parents. The main reason is the relatively large share of additive gene effects and their interaction with the dominant ones [1] (Table 3). Furthermore, in TEE in cross of Obri there is no non-allelic interactions.

Valuable for the breeding in the direction of early ear heading and later ripening are early varieties Galatea, Enola and partly Iveta. For each of them has information from previous studies (Tsenov, 2005a; Tsenov et al., 2005), which in general is not undermined. All three varieties have the ability to extend the period to maturity as a result of high tolerance to fungal diseases, especially Galatea (Tsenov and Tsenova, 2011). That ability is the reason their earliness (TEE) could be combined with high productivity in line with their participation (Tsenov and Atanassova, 2007). The latest in ear emergence populations are populations with participation of a variety Kaloyn. In the backcross with it in some of the crosses were obtained later plant itself (heterobeltiozis). Apparently its genetic control is based primarily on dominant genes for late DEE. Data fully confirm previous findings for this variety (Tsenov and Tsenova, 2011). It should not be used for any other reason. Its behavior with respect to the period until physiological maturity shows a completely different genetic control based on additive factors. That variety reacted strongly to environmental conditions and generally emerge later but accelerated ripening, like varieties with early ear heading (Tsenov, 2009). As already pointed out, this makes it difficult for the breeding in the direction of a combination of grain yield and length of the growing season. Therefore you should look for varieties that ear early, mature late, but flaring from the high temperatures in June. High grain yields in England, France, Germany and others. Nordic countries, in the present day, due but just extending the period to maturity from ear emergence (Griffiths et al., 2009). In strategic approaches for future breeding in some countries one of the main tasks is to "download" earlier ear heading through which practically will extend the said period, mainly through the transfer of genetic factors from Europe to Australia (Eagle et al., 2009) in order to effectively counter the annual drought.

**Conclusion**

Genetic control of the traits of ear emergence date and time to physiological maturity is too complex to be studied in detail with respect to the breeding of wheat. When crossing varieties with a significant difference in the traits studied inheritance is in the direction of the later dates, suggesting that selection of early forms it is advisable to make backcrosses. When performing backcross the inheritance changes significantly in direct proportion to recurrent participation (TEE) could be combined with high productivity in line with their participation (Tsenov and Atanassova, 2007). The latest in ear emergence populations are populations with participation of a variety Kaloyn. In the backcross with it in some of the crosses were obtained later plant itself (heterobeltiozis). Apparently its genetic control is based primarily on dominant genes for late DEE. Data fully confirm previous findings for this variety (Tsenov and Tsenova, 2011). It should not be used for any other reason. Its behavior with respect to the period until physiological maturity shows a completely different genetic control based on additive factors. That variety reacted strongly to environmental conditions and generally emerge later but accelerated ripening, like varieties with early ear heading (Tsenov, 2009). As already pointed out, this makes it difficult for the breeding in the direction of a combination of grain yield and length of the growing season. Therefore you should look for varieties that ear early, mature late, but flaring from the high temperatures in June. High grain yields in England, France, Germany and others. Nordic countries, in the present day, due but just extending the period to maturity from ear emergence (Griffiths et al., 2009). In strategic approaches for future breeding in some countries one of the main tasks is to "download" earlier ear heading through which practically will extend the said period, mainly through the transfer of genetic factors from Europe to Australia (Eagle et al., 2009) in order to effectively counter the annual drought.

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The manuscript should be structured as follows: Title, Names of authors and affiliation address, Abstract, List of keywords, Introduction, Material and methods, Results, Discussion, Conclusion, Acknowledgements (if any), References, Tables, Figures.

The title needs to be as concise and informative about the nature of research. It should be written with small letter /bold, 14/ without any abbreviations.

Names and affiliation of authors
The names of the authors should be presented from the initials of first names followed by the family names. The complete address and name of the institution should be stated next. The affiliation of authors is designated by different signs. For the author who is going to be corresponding by the editorial board and readers, an E-mail address and telephone number should be presented as footnote on the first page. Corresponding author is indicated with *

Abstract should be not more than 350 words. It should be clearly stated what new findings have been made in the course of research. Abbreviations and references to authors are inadmissible in the summary. It should be understandable without having read the paper and should be in one paragraph.

Keywords: Up to maximum of 5 keywords should be selected not repeating the title but giving the essence of study.

The introduction must answer the following questions: What is known and what is new on the studied issue? What necessitated the research problem, described in the paper? What is your hypothesis and goal?

Material and methods: The objects of research, organization of experiments, chemical analyses, statistical and other methods and conditions applied for the experiments should be described in detail. A criterion of sufficient information is to be possible for others to repeat the experiment in order to verify results.

Results are presented in understandable tables and figures, accompanied by the statistical parameters needed for the evaluation. Data from tables and figures should not be repeated in the text. Tables should be as simple and as few as possible. Each table should have its own explanatory title and be typed on a separate page. They should be outside the main body of the text and an indication should be given where it should be inserted.

Figures should be sharp with good contrast and rendition. Graphic materials should be preferred. Photographs to be appropriate for printing. Illustrations are supplied in colour as an exception after special agreement with the editorial board and possible payment of extra costs. The figures are to be each in a single file and their location should be given within the text.

Discussion: The objective of this section is to indicate the scientific significance of the study. By comparing the results and conclusions of other scientists the contribution of the study for expanding or modifying existing knowledge is pointed out clearly and convincingly to the reader.

Conclusion: The most important consequences for the science and practice resulting from the conducted research should be summarized in a few sentences. The conclusions shouldn’t be numbered and no new paragraphs be used. Contributions are the core of conclusions.

References:
In the text, references should be cited as follows: single author: Sandberg (2002); two authors: Andersson and Georges (2004); more than two authors: Andersson et al., (2003). When several references are cited simultaneously, they should be ranked by chronological order e.g.: (Sandberg, 2002; Andersson et al., 2003; Andersson and Georges, 2004).

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