

Ear Development of Some local and Australian Wheat Varieties In Different Temperature Regimes

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SUMMARY

The effects of three day /night temperature regimes (15/10, 20/15, and 25/20 for 12/12 hr) on growth and development of ears in eight varieties of two groups of wheat (Local and Australian) Triticum aestivum L. were studied in laboratory.

The results showed that the spikelet number increased slightly by increasing temperature from 15/10 up to 20/15 c . Whereas , further increase in temperature decreased it in most varieties . the rate of spikelet initiation was also enhanced , but almost the duration of the vegetative and spikelet phases and the apex length at flower initiation reduced in almost all varieties when the temperature was increased to 20/15 c . With further increase in temperature , the rate of spikelet initiation and apex length decreased in all varieties , but the duration of vegetative and spikelet phases either increased or slightly changed .

In general, the superiority of Australian varieties was evident. Moreover, the correlation between some plant characters were shown.

INTRODUCTION

It is well documented that the temperature is one of the important environment factors playing an important role in flower initiation and ear development, including spikelet number per ear. Flowering time in wheat is largely controlled by photoperiod and temperature (1) . Low temperature during the early stages of growth hasten development in varieties which have a vernalization response , but delay development in others (2) . It was found that a decrease in temperature from 20 to 15 c delayed flower initiation of wheat by about 2 days and increased spikelet number by approximately one per ear . Further

increases in temperature decreased spikelet number greatly, although development was much faster (3).

It was observed that environmentally – induced difference in spikelet number arose through effects on the number of primordia present at double ridge initiation and on the subsequent rate of duration of spikelet primordium production (8).these observation have been claimed in subsequent studies (4).It was obtained marked variation in vegetative phase i.e time of flower initiation but little effect on spikelet number per ear by varying temperature from 10 to 30 c (5)

It was found a small effect on spikelet number when plants were grown at three temperature 25/20, 20/15, and 15/10 c) (6). It was observed a curvilinear relationship between temperature (10 – 30 c) and spikelet number per ear and it was claimed that the increase in the number spikelets per ear was due to a large apex with a higher number ridges of flower initiation (3). It was examined the effect of temperature (27/16, 27/21, 32/21 c) on the rate of development of the wheat variety Mexico 120. By transferring plants at flower initiation from one temperature to another and it was also found that temperature condition during vegetative phase influenced later development (7). In another study it was found no effect of temperature (30/15 and 35/18 c) during the vegetative phase on spikelet per ear (8). It was found that spikelet number in varieties kalyansona and condor was lower at 27/12 c and higher at 21/16 c prevailing before the double ridge stage (9). They also found that by transferring the plants from one temperature to another after the double ridge also affected final spikelet

number was found earlier (10), but the results were also small and increased significantly only in condor raised at 27/22 c. Moreover, they showed that the development duration i.e. vegetative and spikelet phased were prolonged when the temperature was decreased from 27/22 to 21/16 c. It was found an increase in the rate of leaf appearance as the temperature raised between 7 and 17 c and a much slower rate above this level and it was also found that the flower initiation was hastened and more phytomers were formed with higher temperature with late variety of wheat charcoal (11). Moreover, it was also found that an increase in temperature over the range 10 - 25 c increased the total number of leaves of and hastened flowering (3).

The main objective of this investigation was to make a comparison between Australian and local wheat varieties as effected by three different temperature regimes. Because in some circumstance the superiority of these Australian varieties in grain yield production was previously emphasized in this region (12,13,14).

MATERIALS AND METHODS

This work was conducted in the plant physiological laboratory / post – graduates at biology department / college of education / Salahaddin University.

The eight wheat varieties four of each Australian (Warrigal, condor, halberd and dagger) and four local ones (Abu _ Ghraib _ 3, Nouri _ 70, Mexipac and Saber _ Beg) were used in the present study. To ascertain the high germination percentage, seeds were previously tested. The seeds were later sown into 15 cm diameter pots (6 seeds/pot) which were filled with silty loam soil of greater zab river – Aski – Kalak and was dried in the oven. The pots were placed in the growth cabinet on 12th November, 1995, under normal

photoperiod (12 hrs) for the experimental duration. Accordingly, the nutrients added to the soil were on the form of mixed fertilizer N : P : K (27 : 27 : 0) at the rate of 320 kg/ha. One growth cabinet was used for each of the three temperature regimes (15/10, 20/15 and 25/20 c) for 12/12 hrs. Replicates and the pots were re randomized daily to minimize the experimental error. The experimental layout was in completely randomized design (C.R.D) with four replicates. Two plants of each variety and replicate of each temperature treatment separately were dissected to determine the onset time of F1. A similar procedure was adapted to determine the time of TSI.

Measurements, all made on the main shoot, were: duration of the vegetative phase (from showing FI) and spikelet phase (from FI to TSI) , number of spikelets , number of double ridges (spikelet primordia) present of FI , apex length at FI , number of phytomers (vegetative nodes) present at FI (11) and final leaf number . Consequently, the rate of spikelet initiation was obtained by subtracting the number of double ridges present at FI from the total number of spikelet dividing by the duration of the

RESULTS AND DISCUSSIONS

It appears obviously from Fig. 1, that the number of spikelet decreased with increase in temperature, but when the temperature was increased from 15/10 to 20/15 c, a significant decrease in spikelet number was notable only in two Australine varieties and one local variety. When the temperature was increased further, there was a significant decrease in spikelet number in all varieties except Warrigal and Abu - Ghraib -3. The size of the decrease depended on the variety, for e.g. the spikelet number in Halberd decreased from 21.0 at 15/ 10 c to 16.1 at 25/20 c, a difference of 4.9, whereas in Abu - Ghraib - 3 the corresponding numbers were 20.3 and 19.7, a difference of only 0.6. This help to explain inconsistencies in literature where large effects are reported in some studies and no effects in other. Thus the large effect reported (3) with variety Marquis was probably attributable to choosing a responsive genotype, whereas (5) obtained little or no effects on spikelet number per ear under different temperature regimes. These environmentally induced differences in spikelet number resulted from the effect on the number on primordia present at double

spikelet phase. The number of phytomers that were converted into spikelet was calculated by subtracting the final leaf number from the number of phytomers present at FI.

Two way ANOVA of statistical analysis was applied. Then, underrequest comparison of the means were made using least significant different (L. S. D.) test at 5% probability . The interpretation of some result was supported by using simple correlation coefficient.

ridge initiation and on the subsequent rate of duration of spikelet primordium production (4). The decrease in spikelet was more evident in local wheat varieties in comparison to that in Australian ones. Thus this may explain for the superiority of Australian varieties under studies in grain yield and quality reported earlier (13,14) over local varieties.

Generally the duration of both phases of all varieties significantly reduced when the temperature was increased from 15/10 to 20/15 c (Figs. 2 and 3) . However when the temperature was further increased from 20/15 to 25/20 c there were in fact slight increases in all varieties except Abu-Ghraib - 3 and Mexipac for the duration of both vegetative phase and except Halberd and Saber-Beg for the duration of spikelet phase. The increase duration of both developmental phases affected by temperature agrees with other observation in wheat (9). Delayed F1 certainly increases the number of reproductive node on the shoot apex of cereals and thus it contributed to higher grain yield in wheat (11).

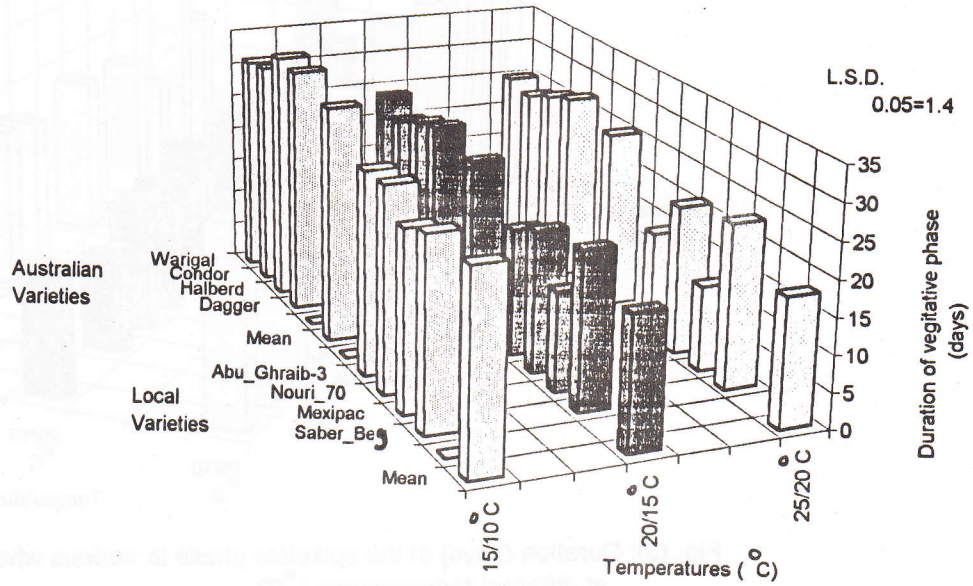


Fig. (2): Duration (days) of the vegetative phase in various wheat varieties at different temperatures (°C).

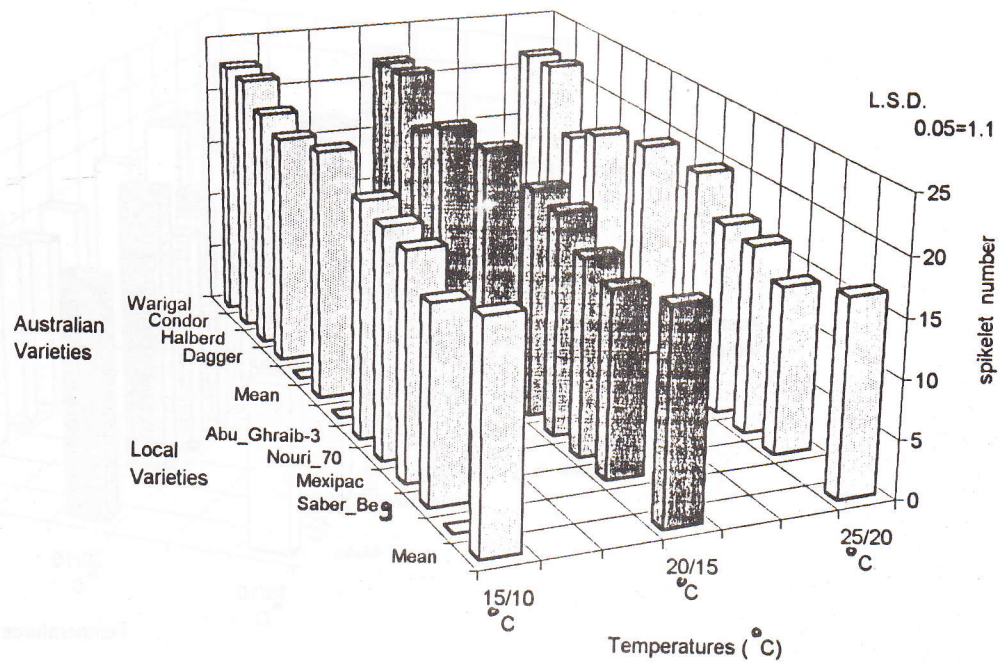


Fig. (1): Number of spikelets per ear in various wheat varieties at different temperatures (°C).

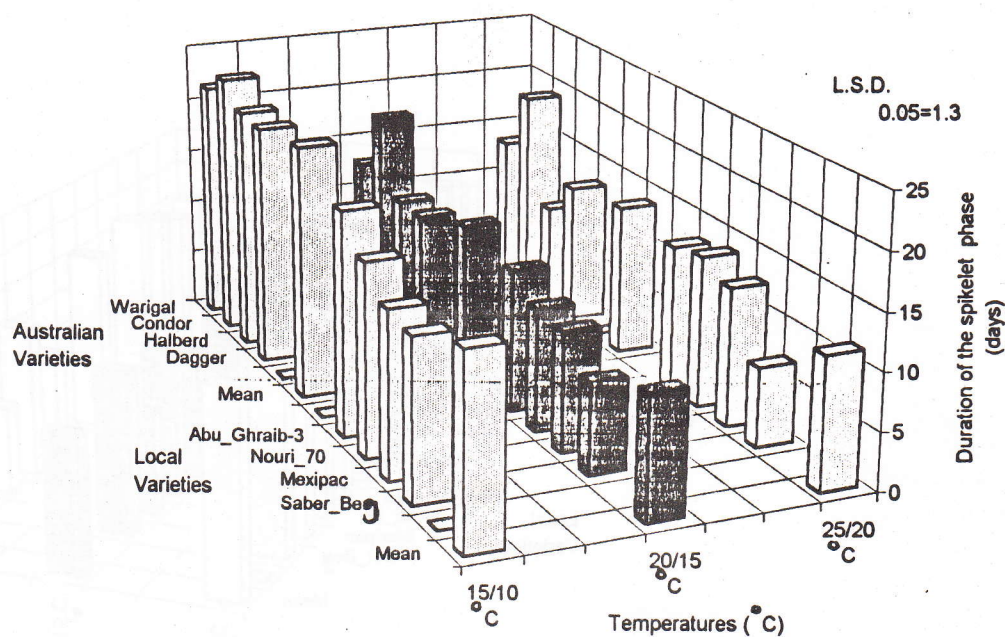


Fig. (3): Duration (days) of the spikelets phase in various wheat varieties at different temperatures (°C).

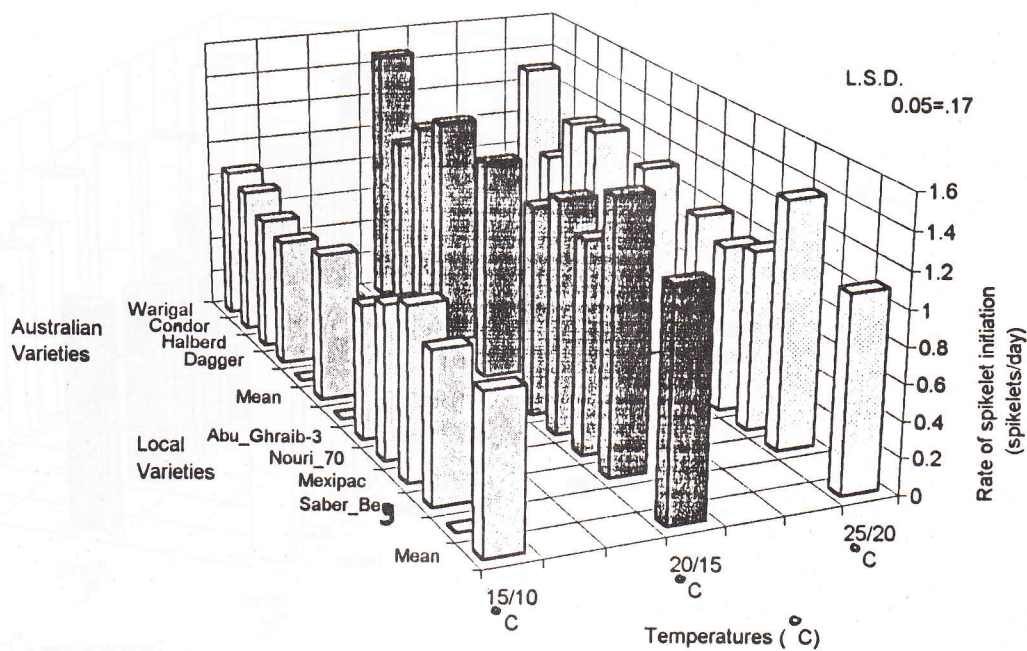


Fig. (4): Rate of spikelet initiation (spikelets per day) in various wheat varieties at different temperatures (°C).

There were a significant positive linear association between duration of vegetative phase and spikelet number ($r = 0.64$, $p = 0.05$) only under 15/10 c regime (Table 1) and this accord with the results of a number of workers (15), and this association has led to the view that length of vegetative phase in a major determinant of spikelet number. Moreover, it was demonstrated (16) the importance of an adequately long vegetative stage which is required to establish the root system and leaf canopy as a basis for later crop growth and it is also needed to establish the tillers and potential spikelet sites.

The positive correlation between apex length and spikelet number ($r = 0.95$ and $r = 0.88$, $p = 0.05$) and between apex length and duration of the vegetative phase ($r = 0.77$, $p = 0.05$) (Table 1) confirm previous finding (4, 17), and are consistent with hypothesis that length of the vegetative phase exerts one of its effects through affecting the length of the apex (4).

Although there were no distinct differences between means of the rate of spikelet initiation of both groups of wheat (Fig. 4). These results could have been another minor determinant for the superiority of Australian varieties on local ones.

The main post - initiation events which have been proposed and determinate of spikelet number are the rate of spikelet initiation and duration of spikelet initiation. It appears from the present results (Figs. 1, 4 and 5) quite clearly the marked effects the temperature on the rate of spikelet initiation and the duration of spikelet initiation relative to the minor effects on spikelet number. Changing the temperature from the 15/10 to 20/15 c caused the rate of spikelet initiation on Saber - Beg for example, to increase from 0.84 to 1.51 spikelet per day and the duration of spikelet initiation phase to decrease from 14 to 8 days, but the spikelet number remained almost constant at

16.4 and following almost the same pattern in other varieties. This inverse relation between the rate and duration of spikelet initiation was also supported further through the negative correlations between the two parameters ($r = -0.55$, NS, $r = -0.69$, $p = 0.05$ and $r = -0.73$, $p = 0.55$) under the three temperature regimes respectively (Table 1).

Whereas, in most varieties a change in temperature had no effect on the number of phytomers at F1, except in Halberd and Saber - Beg it caused a small but significant decrease in number of phytomer (Table 2). Thus the minimum phytomer would seem to be determined before germination in all varieties, while, in Halberd and Saber - Beg, they are probably different maturity genotypes. F1 is usually more or less more effected i.e. delayed by genetic responses to the growing season (11) particularly in Halberd where vegetative phase was not prolonged with further increased in temperature from 20/15 to 25/20 c. Moreover, more phytomers were significantly converted into spikelet under 15/10 c than under 25/20 c in all varieties, but the rate of leaf initiation (final leaf number divided by duration of the vegetative phase) increased in all varieties except Halberd and Saber - Beg. These results agree with other observations in wheat (3, 11) and with the hypothesis that when the rate of leaf initiation is high, leaves compete more strongly than spikelet for the available sites (4). Besides, there were significant differences between the means of the two groups of wheat in number of phytomers that were converted into spikelet. Thus, these findings might contribute a good explanation for the superiority of Australian varieties on local ones.

It appears that the higher the final leaf number the higher the intercepting radiation and providing assimilate for the developing

Table (1): Matrix of simple correlation coefficient between different parameters in eight wheat varieties at different temperatures ($^{\circ}\text{C}$)

Parameters	Temperatures ($^{\circ}\text{C}$)		
	15/10 $^{\circ}\text{C}$	20/15 $^{\circ}\text{C}$	25/20 $^{\circ}\text{C}$
Between duration of vegetative phase (days) & spikelet number	$r=0.64$ $p=0.05$	$r=0.45$ NS	$r=0.20$ NS*
Between apex length (mm) & spikelet number	$r=0.95$ $p=0.05$	$r=0.88$ $p=0.05$	$r=0.30$ NS
Between apex length (mm) & duration of vegetative phase (days).	$r=0.77$ $p=0.05$	$r=0.53$ NS	$r=0.57$ NS
Between rate of spikelet initiation & duration of spikelet initiation phase (days)	$r=-0.55$ NS	$r=-0.69$ $p=0.05$	$r=-0.73$ $p=0.05$
Between number of phytomers that were converted into spikelets & spikelet number	$r=0.80$ $p=0.05$	$r=0.17$ NS	$r=0.11$ NS

* NS = Not significant

Table (2): Number of phytomers present at flower initiation, final leaf number and number of phytomeres that were converted into spikelets in various wheat varieties at different temperatures ($^{\circ}\text{C}$).

Varieties	Phytomer number			Final leaf number			Phytomers, converted into sps.		
	15/10 $^{\circ}\text{C}$	20/15 $^{\circ}\text{C}$	25/20 $^{\circ}\text{C}$	15/10 $^{\circ}\text{C}$	20/15 $^{\circ}\text{C}$	25/20 $^{\circ}\text{C}$	15/10 $^{\circ}\text{C}$	20/15 $^{\circ}\text{C}$	25/20 $^{\circ}\text{C}$
Australian vars.									
Warigal	14.2	14.2	14.2	9.7	10.7	11.5	4.5	3.5	2.7
Condor	13.2	13.2	13.2	10.1	10.7	11.1	3.1	2.5	2.1
Halberd	13.6	13	12.6	9.7	9.7	8.9	3.9	3.3	3.7
Dagger	13.6	13.2	13.2	10.1	9.7	11.1	3.5	3.5	2.1
Mean	13.7	13.4	13.3	9.9	10.2	10.8	3.8	3.2	2.7
Local vars.									
Abu-Graib-3	11.9	11.9	11.7	8.7	9.1	10.1	3.2	2.8	1.6
Nouri-70	11.5	11.5	11.7	8.7	8.9	10.1	2.8	2.6	1.6
Mexipac	11.7	11.7	11.7	8.4	8.8	9.8	3.3	2.9	1.9
Saber-Beg	10.5	9.9	9.3	8.5	7.1	7.5	2	2.8	1.8
Mean	11.4	11.3	11.1	8.1	8.5	9.4	2.8	2.8	1.7
L.S.D. (P=0.05)	0.6			0.7			0.3		

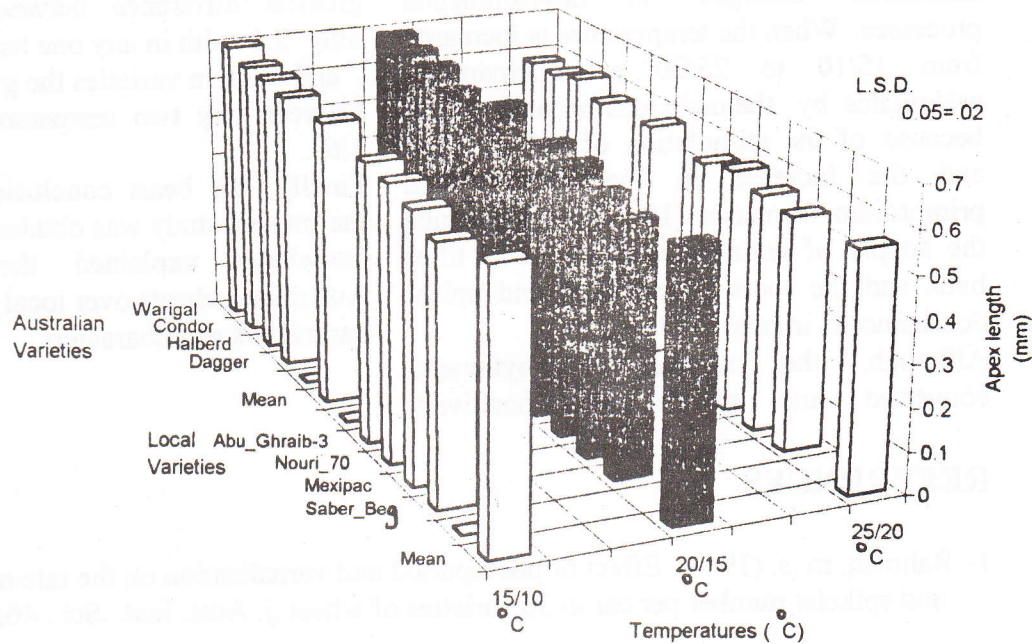


Fig. (5): Apex length (mm) at flower initiation in various wheat varieties at different temperatures (°C).

ear and for grain growth (18). From the previous results, the following explanation is offered to a count generally for the inverse effects of increasing temperature on ear and associated changes in developmental processes. When the temperature is increased from 15/10 to 25/20 c the demand for assimilates by the main axis become greater because of the stimulation of cell division and the increase in the rate of leaf primordium formation (19). In consequence the supply of assimilates available for tiller buds and the roots is restricted and apical dominance is increased (3).

Although, the number of phytomers, converted into spikelet was positively

correlated with spikelet number ($r = 0.80$, $p = 0.05$) number 15/10 c regime only (Table 1), this could have only been a minor determinant of spikelet number, since the greatest difference between varieties was only 2.1 with in any one temperature regime, and with in varieties the greatest difference between any two temperature regimes was 1.6.

Finally, the best conclusion gained from the present study was obtained the significant knowledge explained the superiority of Australian wheats over local ones in different parameters and characters.

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گهشه کردنی چهند توخمیک له گهنم له جۆری خوّمالی و ئوسترالی له ژێر چهند پلهیهکی گهرمی

جیاوازا

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کورتە

لیکۆلینهوهیهک ئه نجام درا دهربارهی سی جور له مامهلهی پلهی گهرما (۱۰/۱۵ ، ۱۵/۲۰ ، ۲۰/۲۵ م) بۆ کاتیکی رووناکی دیاری کراوه (۱۲ کات ژمیر) له سههر گهشه کردنی گولی ههشت توخم له گهنم له جۆری خوّمالی و بیانی (ئوسترالی) له لایهتی خویندی باله له بهشی زانستهکانی ژیان / کولژی پهروهده - زانکۆی سهلاحه دین - ههولیر له ۱۹۹۵/۱۱/۱۲ ..

ئه نجامی توێژینهوه که روونی کردهوه که ژماره ی کولنکهکان (spikelets) به رهو زیاد بوون چوو به بهرزبوونهوهی پلهی گهرما له ۱۰/۱۵ بۆ ۱۵/۲۰ م به لایم فره زیاد بوون له پلهی گهرمادا بوه که م بوونهوهی کولنکهکان له زۆریهتی توخمی گهنمهکان ، ههروهها زۆربوونی ژماره ی کولنکهکان به بهرزبوونهوهی پلهی گهرما . به لایم زیاد بوونی پلهی گهرما له ۱۰/۱۵ بۆ ۱۵/۲۰ م بووه هۆی دریزبوونهوهی ماوهی نیوان گهشه کردنو دروست بوونی کولنکهکان وه بهرزبوونهوهی لوتکهی گهشه له قۆناغی دروست بوونی گول کردن له زۆریهتی ئه و توخمه گهنمانه ی له م توێژینهوهیهدا لیکۆلینهوهی له سههر ئه نجام درا . فره بهرزبوونهوه له پلهی گهرما بووه هۆی کوم بوونهوهی تیکرای دروست بوونی کولنکهکان و بهرزبوونهوهی لوتکهی گهشه له زۆریهتی توخمه کانا . به لایم ههچ گورانکاریهکی روون نه دا له نیوان ماوهی گهشه کردنو ماوهی دروست بوونی کولنکهکان .

به گهشتی توخمی گهنمه ئوسترالیهکان له زۆریهتی ئه و سیفاتانهی له م لیکۆلینهوهدا ئه نجام درا باشتربوو له توخمه خوّمالیهکان چکه له وهش په یوهندی هه بوو له نیوان ههندی له و سیفاتانهی لیکۆلینهوهی له سههر ئه نجام درابوو .

نمو السنبلة في ثمانية أصناف من الحنطة المحلية والأسترالية تحت نظم مختلفة من درجات الحرارة

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الخلاصة

تمت دراسة تأثير ثلاث معاملات حرارية (۱۰/۱۵ ، ۱۵/۲۰ ، ۲۰/۲۵ م) ولفترة ضوئية محددة (۱۲ ساعة) على نمو وتطور السنبال لثمانية أصناف في نوعين من الحنطة المحلية والأسترالية في مختبر الدراسات العليا - قسم علوم الحياة - كلية التربية - جامعة صلاح الدين - أربيل في ۱۹۹۵/۱۱/۱۲ .

أظهرت النتائج بان عدد السنبالات قد ازدادت قليلا بزيادة درجة الحرارة من ۱۰/۱۵ إلى ۱۵/۲۰ م بينما الزيادة الإضافية في درجة الحرارة أدت إلى انخفاضه في كثير من الأصناف وكذلك لوحظت الزيادة في معدل تكوين السنبالات بارتفاع درجة الحرارة . إلا أن الزيادة في درجة الحرارة من ۱۰/۱۵ إلى ۱۵/۲۰ م أدت إلى تقليل طول الفترتين الخضرية وتكوين السنبالات وارتفاع الغلة النامية في مرحلة تكوين السنبالات الزهرية في الكثير من الأصناف . أن الزيادة الإضافية في الدرجة الحرارة قد قللت من معدل تكوين السنبالات وارتفاع الغلة النامية في معظم الأصناف . لكن لم تحصل تغيرات واضحة في طول الفترتين الخضرية وتكوين السنبالات . عموما ، تغلب الأصناف الأسترالية على غيرها من الأصناف في معظم الصفات المدروسة . إضافة إلى ذلك لوحظت علاقات ارتباطية بين بعض الصفات النباتية المدروسة .