Journal of Agricultural, Environmental and Veterinary Sciences
Issue (4), Volume 1
December 2017
ISSN: 2518-5780

المجلة العربية للعلوم و نشر الأبحاث
Arab Journal of Sciences & Research Publishing
AJSRP

Branching (tillering) in the plant of the (cereals) such as bread wheat (Triticum eastivum L.) and barley (Hordeum vulgare L.)

ZEDDIG houda **BENLARIBI mostefa.**

University of Brother Mentouri Constantine 1 || Algeria

Abstract: Two genotypes of wheat (Triticum estivum L.) Mahon demias , Mexipak and two genotypes of barley (Hordeum vulgare L.) Rihane and Saida , were studied in the vitreous house of the D.V.R.P laboratory at the University of Brothers Mentouri Constantine 1 (Algeria) , the anatomical study was performed in stage 4 leaves (4L) in the Tillering tray using the manual method and then coloring the sections with the carmine-green , observations under light microscope showed a variation in species in both varieties and in both genus : Mahon demias in bread wheat was formed 4 tillers buds , while Mexipak in bread wheat was formed 3 tillers buds , while Saida gave only two buds with the observation that barley was early in the composition compared to bread wheat.

Keywords: Anatomy, Bud, Tillering, Triticum eastivum L. , Hordeum vulgare L.

Introduction

Tillering is one of the key components for improving grain yield in temperate cereals, such as wheat (Triticum aestivum L.) and barley (Hordeum vulgare L.) (Sreenivasulu and Schnurbusch, 2012; Kebrom et al., 2013 ; Hussien et al., 2014; Alqudah et al., 2016). Cereals are able to maximize grain yield through increased tillering (Evers and Vos, 2013) and increasing the number of fertile tillers (bearing fertile spikes) was proposed as one of the most important components for grain yield in wheat and barley (Sreenivasulu and Schnurbusch, 2012; Xie et al., 2016). Therefore, the development of crop varieties with optimal tiller number for a specific environment could play an important role in efforts to increase yield (Kebrom and al., 2012). In cereals, bud outgrowth into tillers (side-branches) happens sequentially after the three leaf stage (Moule, 1971; Kirby and Appleyard, 1987). The number of developing tiller buds or bud outgrowth is influenced by growing conditions such as light and water (Doust, 2007; Evers and Vos, 2013; Kebrom et al., 2013).

The branching of the root intervenes relatively behind the growth zone while the tissue differentiation is already completed. The origin of lateral roots and rootlets is a so-called endogenous deep origin, which is opposed to the exogenous surface origin of branches and leaves (Deysson, 1967; Pudall, 2007; Da Costa et al., 2013).

Tiller or branch development is a two-step process: initiation of a meristem in the axil of a developing leaf to form a bud, followed by bud outgrowth. In some cases the bud is dormant as a result of

complex interactions between endogenous developmental signals and environmental factors (Kebron et al., 2012)

Branches or tillers develop from buds that are formed from meristems initiated in the axil of leaves. The buds may grow and form branches or become dormant in response to developmental and environmental signals that promote or inhibit bud outgrowth. Developmental signals are those associated with the status of the shoot apical meristem as a vegetative or floral meristem and the overall growth of the plant. Environmental signals that modulate tillering include availability of water, nutrients, temperature, light quality and quantity. The effects of developmental and environmental signals are integrated and transmitted through variation in hormonal and metabolic signals that act within or outside the buds (Tavakol et al., 2015).

The objective of this study is to observe the origin of tillers by histological sections in order to choose the genotypes with high tillering potential.

Materials and Methods

1. Plant material used:

The study involved 04 genotypes of differing origins. 02 genotypes of bread wheat *(Triticum aetivum L.):* Mahon Demias, Mexipak and 02 genotypes of barley *(Hordeum vulgare L.):* Rihane and Saida, Our work was performed at the Laboratory of Development and Valorisation of phytogénétiques Resources D.V. P .R, Faculty of Natural Science and Life at the University of Constantine 1 (Algeria).

2. Experimentation:

The planting is done in pots 20cm high, rectangular section 27 cm length and 18 cm width installed in a vitreous house. according to a device of 4 repetitions for each variety. The pots are filled with an homogeneous agricultural soil taken from the nursery of the Apicole center (Affiliate University of Constantine 1). At a density of 8 grains / pot. agriculture was the same conditions for all varieties. The irrigation of the plants is undertaken regularly at the rate of once a week during the initial phases and the quantity of water supplied is 250 ml / pot twice a week.

3. Histological study:

After the 4 leaves stage (early tillering), was attention to the party of Tillering- tray. Anatomical sections using manual method with the aid of razor blade, and then the coloring process was carmine-green iodine or Carmine-green of Mirande (Isabelle, 2008) Follow these steps According to (Johanson, 1940; 2000 ،بوغديري ; Roger, 2008)

1. Place the syrup in an Watch glasse containing sodium hypochlorite for 15 minutes. Sodium hypochlorite (basic) digests all cell contents. Only the pecto-cellulosic walls are preserved.
2. The Sections get about To a second watch glasse containing water for 2 minutes to get rid of sodium hypochloride (NaOCl).
3. The sections get about to a third watch glasse containing Acetic acid (CH 3 COOH) 1% and leave for 5- 10 minutes. Acetic acid neutralizes the excess of bleach which has the property of denaturing the dyes and causing the tissues to lose color. In addition, the acetic acid renders the cell walls receptive to the dye. This receptivity promotes and improves the fixing of the color.
4. The sectios get about to a forth watch glasse containing Carmine-green of Mirande or carmine-green iodine for 3 minutes.
5. the sections get about to an watch bottle containing distilled water for 1 minute to get rid of excess color.

The colored sections are placed in a drop of glycerin on a slide and covered with a catheter and examined under the optical (light) microscope Leica type, and take pictures with the camera.

Results

According to the results of the histological sections obtained The number of branches (tillering) shows the existence of the inter and intra - specific diversity of the two Triticum and Hordeum.

Through the anatomical sections of the bread wheat plant during stage phase 4 leaf as show in Figure (1), and (2), note the variety Mahon demias formed 4 bud tiller compared with variety Mexipak which formed 3 bud tiller. While in the barley plant during stage 1 tiller in Figure (2), and (3) observed the variety Rihane formed more tillers in comparison with variety Saida.

1. Variety of bread wheat

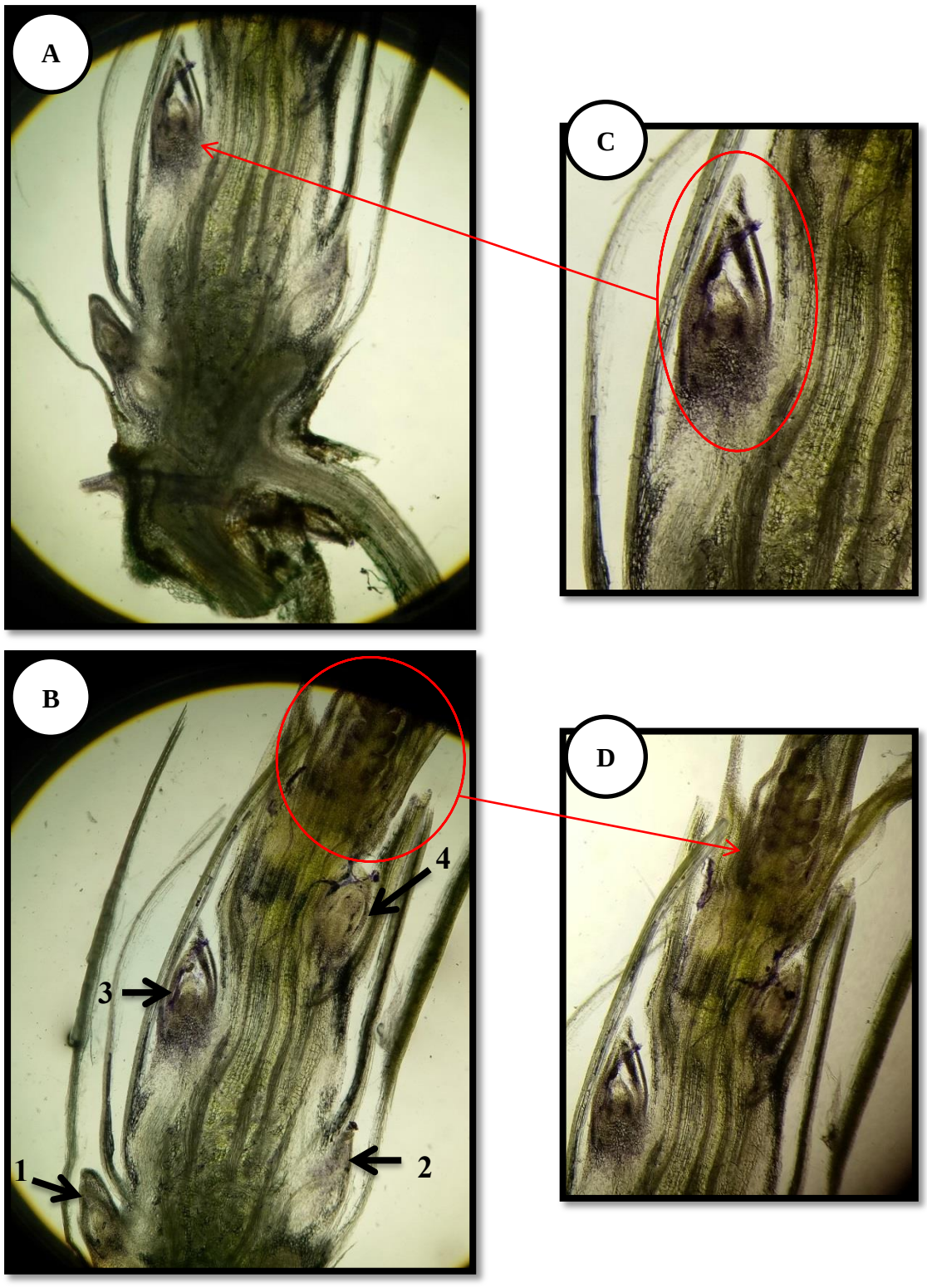

Figure (1) Longitudinal section the Tillering tray of variety Mahon Demias (stage 4 leaves) .Visualization in photonic microscope colored by carmino-green (4 X 0.1). A ,B tillering- tray.C : tiller bud, D : apex.

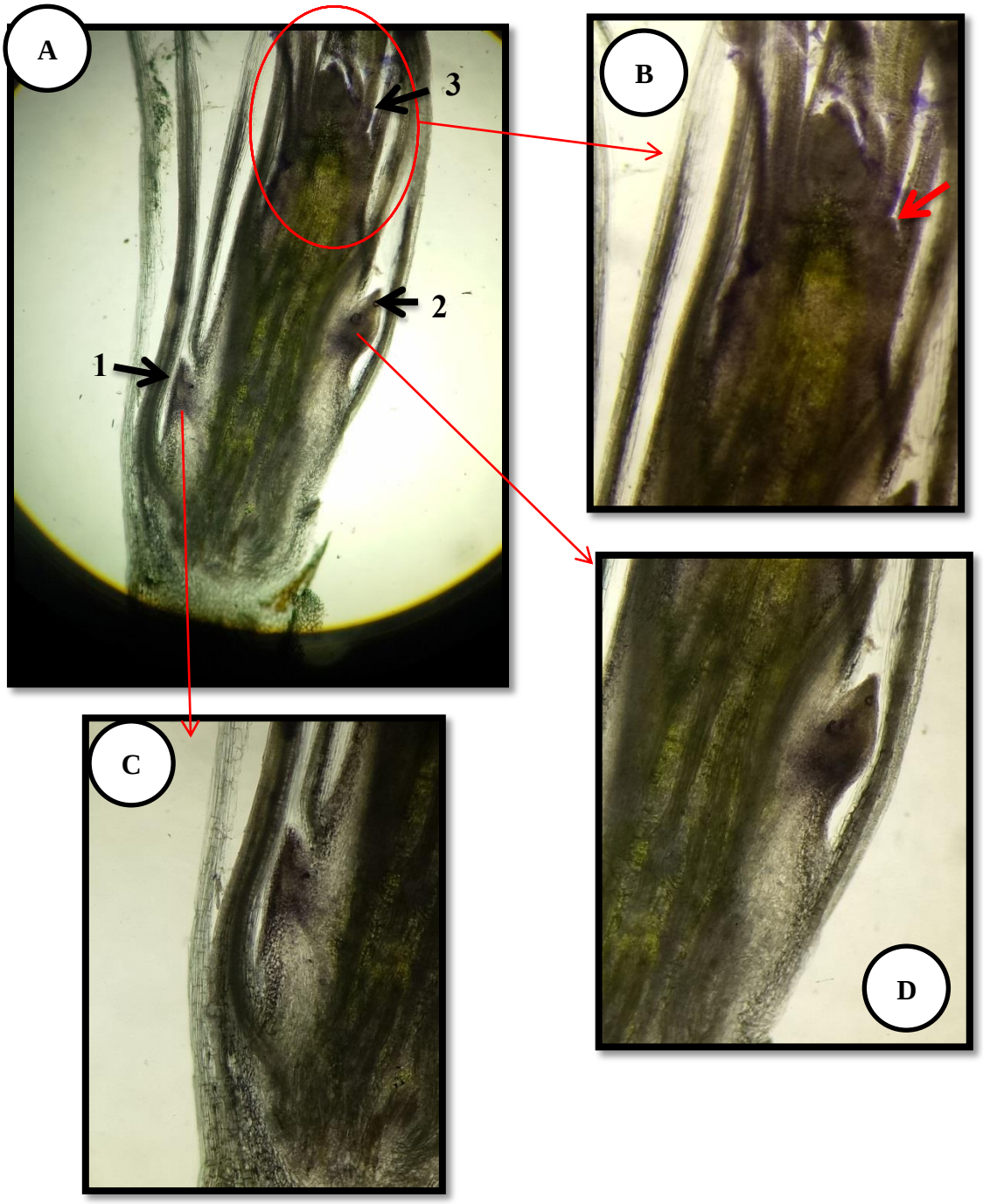

Figure (02) Longitudinal section the Tillering- tray of variety Mexipak (stage 4 leaves) Visualization in light microscope colored by carmino-green (4 X 0.1). A tillerin- tray. B: section of Apex, C and D : Bud tiller.

1. Variety of barley

Figure (03) Longitudinal section the Tillering- tray of variety Rihane (stage 1 tiller) Visualization in light microscope colored by carmino-green (4 X 0.1). Arrows in each image indicate the position of the shoot apex of the tiller.

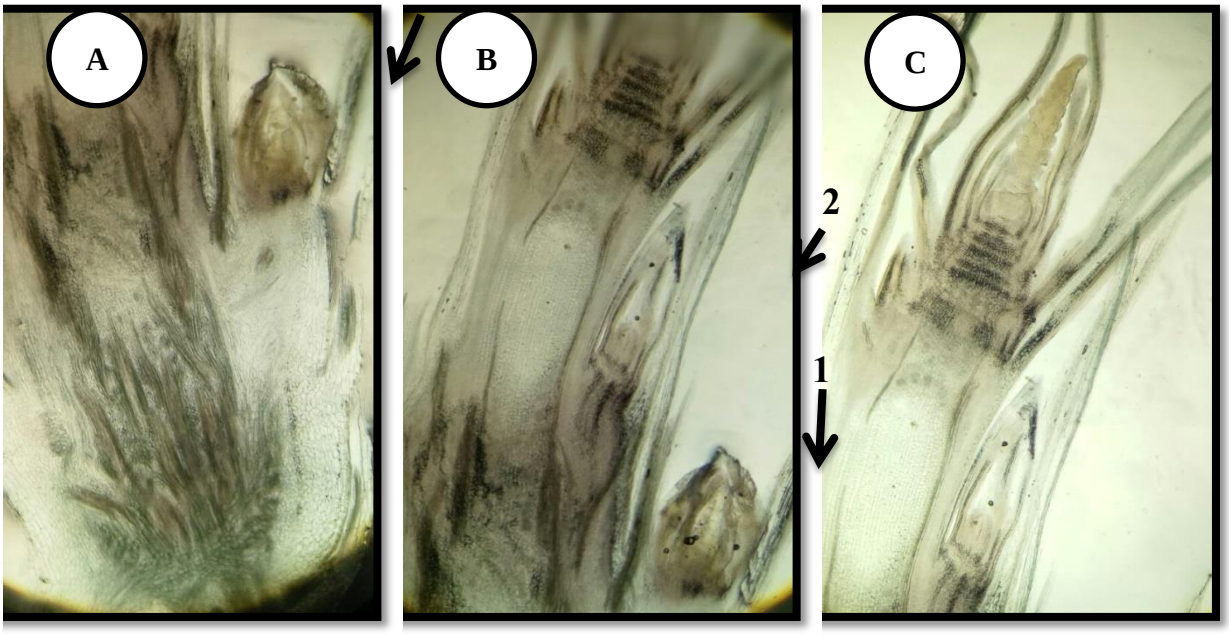

Figure (04) Longitudinal section the Tillering- tray of variety Saida (stage 1 tiller) Visualization in light microscope colored by carmino-green (4 X 0.1). Arrows in each image indicate the position of the shoot apex of the tiller.

Discussion

Wheat and barley plants develop tiller buds in the axil of each leaf as show in the Figures (1), (2), (3), and (4). The developpment of these buds is sequential and corresponds to the developpment of the subtenting leaves These results were consistent with (Livingston et al., 2013). The first tiller buds of the first leaves in the wheat and barly that is axillary cell division (Fig1.2.3.4) and differentiation of the first several axillery leaf primordia These results were consistent with (Li et al., 2003).

The rate of appearance of successive tillers and the leaf appearance rate of those tillers were similar to the appearance rate of main shoot leaves as show in Figure (1), and (2). These results were consistent with (Porter, 1985 ; Rickman et al., 1985).

Tiller Development in Barley Plant development is a continual process of organogenesis involving the activity of meristems, pluripotent stem cell populations present in different parts of the plant (Hussein et al., 2014). Shoot architecture is ultimately determined by the activity and determinacy of the SAM and AXMs (Wang and Li, 2008).

Depending on endogenous and environmental signals, an axillary bud may remain dormant or grow into a tiller. and according to his findings (Hussein et al., 2014) Each tiller is a new axis of growth, organized like the main culm in phytomer units. Each tiller harbors new axillary buds that may in turn develop new tillers in a reiterative pattern (Fig. 3.4). Tillers, therefore, develop in acropetal succession with primary tillers arising from axillary buds of the main culm, secondary tillers growing out of leaf axils of primary tillers, and so on (Benlaribi et al., 1990, Livingston et al., 2013). After the transition of the main culm SAM from a vegetative to a reproductive state, young tillers undergo senescence, possibly because nutrients are routed away from developing tillers to the elongating internodes. Axillary meristem establishment and formation of the axillary bud are mostly under genetic control, while bud outgrowth is regulated by a complex network of genetic, hormonal, and environmental factors (Kebrom et al., 2013).

Conclusion

The ability (capacity) to form the tillers buds is a genetic characteristic that allows the determination of the architecture of the shoot, The origin of these tillers is buds, each tiller has the potential to produce a seed-bearing inflorescence and, hence, increase yield.

References

1. بوغديري الغربي (2000) *دروس و تطبيقات في علم النبات*. ديوان المطبوعات الجامعية (02-2000) الساحة المركزية- بن عكنون- الجزائر.
2. Alqudah A. M , Koppolu, R, Wolde G. M, Graner A , and Schnurbusch T (2016) : The Genetic Architecture of Barley *Plant Stature*. PMCID: PMC4919324 Published online 2016 Jun 24. doi: 10.3389/fgene.2016.00117

3. Benlaribi M., Monneveux P et Grignac P., (1990) :Etude des caractéres d'enracinement et de leurs roles dans l'adaptation au déficit hydrique chez le blé dur (*Triticum durum Desf.)*. Agronomie, EDP Sciences, 1990, 10 (4), pp.305-322. *HAL* Id: hal-00885291. . P 19
4. Da Costa, C., M.R. de Almeida, C.M. Ruedell, J. Schwambach, F.S. Maraschin, and A.G. Fett-Neto. (2013) : When stress and development go hand in hand: main hormonal controls of adventitious rooting in cuttings. Front. *Plant Sci*. 4, 1-19. Doi: 10.3389/fpls.2013.00133.
5. Deysson Guy. (1967) : *organisation et classification des plantes vasculaires premiére partie : organisation générale.* Tome II.SEDES PARIS.
6. Doust A. N. (2007) : *Grass architecture: genetic and environmental control of branching.* Curr. Opin.
7. Evers J. B., Vos J. (2013) : Modeling branching in cereals. Front. *Plant Sci*. 4:399. 10.3389/fpls.2013.00399
8. Hussien A, Tavakol E, Horner DS, Muñoz-Amatriaín M, Muehlbauer GJ, Rossini L (2014) : Genetics of tillering in rice and barley. *The Plant Genome*: Posted 13 Jan. 2014; doi: 10.3835/plantgenome2013.10.0032
9. Johansen DA. (1940) : *plant microtechnique*. New-New-York : McGraw-Hill, 523p.
10. Kebrom T. H., Chandler P. M., Swain S. M., King R. W., Richards R. A., Spielmeyer W. (2012) : Inhibition of tiller bud outgrowth in the tin mutant of wheat is associated with precocious internode development. *Plant Physiol.* 160, 308–318. 10.1104/pp.112.197954
11. Kebrom T. H., Spielmeyer W., Finnegan E. J. (2013) : Grasses provide new insights into regulation of shoot branching. *Trends Plant Sci*. 18, 41–48. 10.1016/j.tplants.2012.07.001
12. Kirby E., Appleyard M. (1987) *: Cereal Development Guide. Stoneleigh:* NAC Cereal Unit.
13. Li X, Qian Q, Fu Z, et al. Control of tillering in rice. (2003) : *Nature*;422:618–621
14. Livingston DP III, Henson CA, Tuong TD, Wise ML, Tallury SP, et al. (2013) : Histological Analysis and 3D Reconstruction of Winter Cereal Crowns Recovering from Freezing: A Unique Response in Oat (Avena sativa L.). *PLoS ONE* 8(1): e53468. doi:10.1371/*journal.pone*.0053468.
15. Moule (1971) : *Phytotechnie Spéciale Céréales* tome II. la maison rustique. Paris. 95 page.
16. Porter JR. (1985) *: Approaches to modelling canopy development in wheat. In: Day W, Akins RK. eds. Wheat growth modelling*. New York: Plenum Press, 69–81.
17. Rickman RW, Klepper B, Peterson CM. (1985) : Wheat seedling growth and development response to incident photosynthetically active radiation. *Agronomy Journal* 77: 283–287.
18. Roger prat, (2008) *: expérimentation en biologie et physiologie végétales (trois cents manipulation*. éditions Quae, (Hermann édition). Page 56-57.
19. Rudall, P. (2007) *: Anatomy of flowering plants: An introduction to structure and development.* 3rd ed. Cambridge University Press, New York, USA. Doi: 10.1017/CBO9780511801709.

20. Sreenivasulu N., Schnurbusch T. (2012) : A genetic playground for enhancing grain number in cereals. *Trends Plant Sci.* 17, 91–101. 10.1016/j.tplants.2011.11.003
21. Tavakol E., Okagaki R., Verderio G., Shariati J. V., Hussien A., Bilgic H., et al. . (2015) : The barley *Uniculme4* gene encodes a BLADE-ON-PETIOLE-like protein that controls tillering and leaf patterning. *Plant Physiol.* 168, 164–174. 10.1104/pp.114.252882
22. Wang, Y., and J. Li. (2008) : Molecular basis of plant architecture. Annu. Rev. *Plant Biol.* 59: 253–79. doi:10.1146/annurev.arplant.59.032607.092902.
23. Xie Q., Mayes S., Sparkes D. L. (2016) : Optimizing tiller production and survival for grain yield improvement in a bread wheat x spelt mapping population. *Ann. Bot.* 117, 51–66. 10.1093/aob/mcv147.

Annex

Green carmine of iodine (or carmine-green of Mirande)

Monday, December 01, 2008 by Isabelle Derambure

http://www.spc.ac-aix marseille.fr/labospc/spip.php?article280

In 200 ml distilled water dissolve

- 6 g Carmin 40 for histology
- 12 g of potassium alum

Heat on low heat

- add 200 ml of distilled water
- 0.4 g of iodine green

Bring to a boil then let cool and filter.

الملخص: تمت الدراسة على نمطين وراثيين من القمح اللين (.Triticum eastivum L) Mahon demias و Mexipak و نمطين وراثيين من الشعير (.Hordeum vulgare L) rihane , و saida ، بالبيت الزجاجي التابع لمخبر D.V.R.P بجامعة الاخوة منتوري قسنطينة 1 (الجزائر)، أنجزت الدراسة التشريحية في مرحلة 4 ورقات (4F) في صينية الاشطاء باعتماد الطريقة اليدوية ثم تلوين المقاطع بالملون المضاعف (أخضر- الكارمن) carmine- green. تبين الملاحظات تحت المجهر الضوئي leica تباين في النوع الواحد عند الصنفين و في الجنسين: فالصنف Mahon demias في القمح اللين و الصنف Rihane في الشعير كونا 4 براعم إشطاء، بينما الصنف Mexipak في القمح اللين شكل 3 براعم إشطاء، في حين الصنفSaida فلم يعطي إلا برعمين مع الملاحظة أن الشعير كان مبكر في تكوين الإشطاء مقارنة بالقمح اللين.

الكلمات المفتاحية: تشريح، برعم، الإشطاء، .Hordeum vulgare L. Triticum eastivum L .