Plant Archives Volume 20 No. 2, 2020 pp. 7967-7970 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

TILLERS PATTERNS OF BREAD WHEAT AND GRAIN YIELD PRODUCTIVITY UNDER ABIOTIC STRESS

Hussein M. Khaeim[1*], Bushra A. Jeber[2], Baker D. Aljawasim[3], Salwan Abdel Muaen Al-khaikani[2] and Ali Ahmed Mohsen[2]

[1*]Department of Horticulture, College of Agriculture, University of Al-Qadisiyah, Iraq.
[1]Department of Horticulture, College of Agriculture, SzentIstvan University- Hungary.
[2]Department of Horticulture, College of Agriculture, University of Al-Qadisiyah, Iraq.
[3]Department of Plant Protection, College of Agriculture, Al-Muthanna University, Iraq.

Abstract

In wheat, *Triticum aestivum* L., tiller production and survival determine final spike number and play very important roles in grain yield formation. This field trial aimed to investigate the genetic and physiological basis of tillers production and its effect on grain yield components. The growth patterns of wheat were controlled by water stress and catalytic stress with fertilizers and treatment time for different varieties. Tillers' numbers were decline in most of the planted wheat varieties, which led to a slight reduction in the final grain yield. Wheat with lower tillers numbers intended to produce a higher quantity of grain yield. They also are efficient in water and fertilizer usage. Water stress presents no effect on grain yield in the main stem and also on plants with limited tillers number. 87% to 100% of the wheat grain is produced by the main stem and T1 and T2. Wheat varieties that produce limited tillers are capable of achieving relatively high yield in drought conditions and less fertilization without sacrificing optimal yield under optimum conditions. This because of the heavier grains, rather than increasing the number of tillers. This coincides with a statistical increase in the ratio of protein and water consumption. Fertilizers, especially nitrogen, play a key role in tillers formation if they applied at the right time. Farmers can utilize nitrogen application time according to what they desire in their field if there want more or fewer tillers formation with consideration to the quality of grain yield.

Key words: Wheat tillers, tillers pattern, Nitrogen, wheat varities, *Triticum aestivum* L.

Introduction

Wheat plants are highly resilient in the number of tillers (lateral branches) they produce. The tillers in the wheat plant are additional stems that develop from the base of the main stem, Phillips, S.B. *et al*., (2004); Jeber, B.A. and Khaeim, H.M., (2019). Primary tiller form within the axons of the first four or more true leaves of the main stem. Secondary tillers may be developed from the base of primary branches if conditions are suitable for the development of branches and there is a genetic predis position to the plant. Tillers' development is enhanced by timely cultivation and application of nitrogen fertilizer, Mariateresa Lazzaro *et al*., (2019); Alawsy *et al*., (2018). The isolated wheat plant that produces large numbers of tillers, many of which reach full maturity. However, densely planted wheat plants can produce only one tiller or produce no branches other than the main stem, Rui Wang *et al*., (2018); A.A. Luma *et al*., (2018). In such cases, the plant invests a greater amount of the biological product in uplift growth, rather than in lateral growth to prevent complete shading of neighboring plants, Ruishi He *et al*., (2018); Khaeim, H.M. *et al*., (2019). This phenomenon is part of what's called shadow avoidance syndrome, which enables plants to cope with future competition to light. One of the environmental determinants of this flexible property of plants is the quality of the light, in particular the ratio of red light to the ratio of distant red light. The adjacent vegetation absorbs most of the red portion of the light spectrum, while most of the distant red light is reflected. This changes the ratio between the intensity of the red and far light, which the plant can perceive as a sign of competing plants in the vicinity, Panfeng Guan, (2018); Khaeim, H.M. *et al*., (2019).

****Author for correspondence :*** E-mail: hussein.khaeim@qu.edu.iq

Nitrogen is the most important nutrient for achieving high yields. Sufficient supplies give larger leaves and thus larger buds as each leaf grows faster. Lack of nitrogen reduces the rate of branching, which reduces the number of potential spikelets. The number of grains per spike increased by 3.2% when the nitrogen level was increased to 300 km.h^{-1}, Ansar *et al*., (2010); Zhiqiang Wang, (2016). The protein content of glutenin in wheat flour is 8-10-15%, which is much less compared to the starch. It has an important role in holding the dough and gaining elasticity and is the most important substance in flour, Khaeim, H.M., Jeber, B.A. and Ali, M.A., (2019).

Wheat gives flour that is suitable to form a paste that retains gases and gives good bread with a light pulp. Gluten is produced when water is applied to the wheat flour protein and it is the element that gives the dough its distinctive characteristics. Although other grains contain it, they do not have similar properties to wheat flour protein, Navjot, K., (2012); Al-Baldawy *et al*., (2019). The protein found in wheat consists of gliadin-glutenin. Gliadin sticks with the application of water and gluten is a cohesive and pigmented mass that has the advantage of being able to expand and simplify. Gelatin is viscous by adding water and gluten, forming a cohesive and gummy mass and is characterized by the ability to stretch and stretch, Xueling Ye *et al*., (2015); Khaeim, H.M., (2013).

Materials and Methods

Five varieties of local bread wheat (Rashid, Ibaa 99, Tamoze 2, Abu Ghraib and Latifa) were planted in the Daggara / Diwaniyah sub-district during the winter season 2019-2020. The study aimed to determine the extent of genes affected by different treatments and the contribution of the main stem and the primary branches (T1, T2, T3) to each of the grain yield and its two types. The agriculture field was present in both locations after cleaning and removing the remnants of the previous crop and the service operations were carried out by plowing, smoothing and leveling. The field was divided into experimental units in both locations with plots of (1 × 1.9) m and a distance of (35) cm was left in between.

The factorial experiment in which a randomized complete block design (RCBD) was used with three replicates. 120 experimental units were performed differently for each of the 60 trial units. The differences in service operations included seeding time, quantity, dates of nitrogen fertilization and irrigation operations, were done. The cultivation was carried out in lines for each of the five varieties after they were distributed randomly, noting that the distance between the lines is (20) cm and the distance within a single line is (10) cm on 10/11/2019.

Table 1: Chemical and physical properties of the soil before planting.

Trait		Value	Unit
Reaction Degree of Soil, pH, (1:1)		7.7	-
Electrical Conductivity of Soil, EC,(1:1)		3.52	DesiSmens. M^{-1}
Cation exchange capacity of soil, CEC		24.72	Cml.charge. kg^{-1}.soil
Carbonate minerals content		240	g.kg^{-1}
Organic matter content		10.89	
Cationic dissolved ions content	**Ca^{2+}**	24.37	Cml.charge.L^{-1}
	Mg^{2+}	14.23	
	Na^{1+}	40.63	
Negative dissolved ions content	**SO_4^{2-}**	16.93	
	HCO_3^{1-}	18.93	
	CO_3^{-2}	Nill	
	Cl^-	40.83	
Available Nitrogen content	**$N-NH_4^+$**	23.52	Mg. kg^{-1}
	$N-NO_3^-$	18.92	
Available phosphorous content		17.01	Mcg.m^{-1}
Available potassium content		168.10	
Bulk Density		1.43	
Soil Separators	Sand	272	g.kg^{-1}
	Loam	539	
	clay	189	
Texture type		Silt Loam Soil	

Samples were taken from the soil and analyzed for chemical and physical properties (Table 1). The field was irrigated, the germination is completely saturated and then the rainfall amounts are relied upon until the end of the season. Plants that were exposed to moisture stress were covered with nylon in frequent abundant rains. Nitrogen fertilizer, in from of Urea, was applied to the experimental units (A1) at the branching stage and the stage of formation of spikes, while the other group (A2) was added after the completion of these two stages. Humus was applied by spraying the vegetative part of the plants for the experimental units (A1) at a concentration of (30) liter^{-1}.

Anti-jungle operations were carried out periodically. Field data were collected, each according to schedule, in tables prepared for this purpose. The numbers of wheat tillers were calculated for all the experimental units after the plants were uprooted at a distance of (30) cm for one of the lines, randomly. Plant heights were measured for each pilot unit at both sites. The length of the strand, the number of spikelets per spike and the weight of a thousand kernels were also taken.

Results and discussion

There is an inverse relationship between the number

Table 2: The number of tillers in plants for both groups, Plant^{-1}.

Varieties of Treatments	Ras-heed	Biho-oth22	Lat-ifa	Iba-a99	Tam-oz 2	Treatment Average
Early planting date (tillers)	8	7	6.8	8.3	5.4	7.1
Late planting date (tillers)	5.1	6.2	5.5	5.4	4.6	5.36

of spikes per unit area and the number of grains/spike^{-1}. This case assumes the existence of a compensation system between these two components knowing that their inheritance coefficient is very high, Scott *et al*., (1989). The tillers whose height is less than two-thirds of the main stem at the end of the tillering stage fail to give spikes, Greaciadel Moral, (1984).

Planting time

Delaying planting dates resulted in fewer wheat tillers because of the shorter plant growth period. Wheat is a cold season crop and gives more productivity when it is planted early, table 2.

Varieties and their genetic expression

There is genetic variability of tillering ability among cultivars. Although environmental factors are usually more important in variety selection, low-tillering varieties may respond differently to yield management compared to varieties with a genetic predisposition to branch more widely (many offshoots). Fig. 1 presents the variability among the planted cultivars. It shows clearly that the variety of Ibaa made the best performance among the other cultivars followed by Rasheed, which significantly differs from Abo-Graib, for example.

$y = (-0.213x + 7.373)$

$R^2 = 0.2352$

Nitrogen management

Nitrogen increases vegetative growth as well as plant tillers. However, tiller formation can be affected by the timing of nitrogen application. The application of nitrogen before or during the tillering stage stimulates the plant

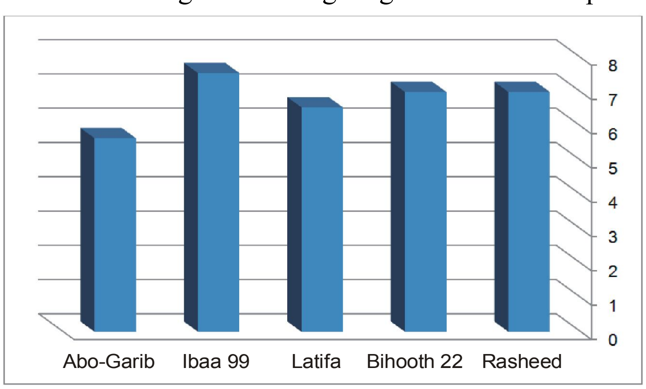

Fig. 1: Presents the variability among the planted cultivars.

Table 3: The effect of the amount and time of nitrogen fertilizer application.

Varieties of Treatments	Ras-heed	Biho-oth22	Lat-ifa	Iba-a99	Tam-oz 2	Treatment Average
N application on the date (tillers)	8.6	8.3	8	9	6.8	8.14
Less amount of N for growth only (tillers)	5	4.4	3	3.9	3	3.86

tillers more according to the ability and genetic expression of different varieties. It can be increased when the nitrogen fertilizer application is done before planting or during the tillage process. To reduce the tiller's number, the greater part of the fertilizer should be applied after the tillage process, before stem elongation. Table 3 present the difference when nitrogen fertilizer applied before the tillering stage (8.14 tillers) and when it applied after this growth stage for plant growth only (3.86 tillers).

Seeding rate

Optimum seeding rates to achieve high yields can vary widely across variety and environment. However, increasing the seeding rate appears to have the greatest effect on reducing the number of tillers without adversely affecting yield. Therefore, it is imperative to increase the seeding rates by (45-50)% according to the cultivar cultivated.

The study varieties exhibited similar behavior in their branching capacity with a linear range from tillering to the maximum number of tillers when well managed and providing all appropriate conditions for growth, especially quantities of water at the field capacity and nitrogen application during the tillering phase. While the other case was demonstrated, the genetic variations and expressions.

Table 4: The effect of tillering on the yield of wheat varieties (gm. M^2).

Varieties of Treatments	Ras-heed	Biho-oth22	Lat-ifa	Iba-a99	Tam-oz 2	Treatment Average
Service to reduce the number of tillers (kg. Dunum)	555.5	627.5	556.3	598.2	684.3	604.36
Crop service to increase the number of tillers (kg. Dunum)	556.2	629.9	530.0	584.0	672.8	594.58
Average (kg. Dunum)	555.85	628.7	543.15	591.1	678.55	

The study concluded that genotypes that produce a small number of spikes with large spikes can achieve relatively high yields under drought and fertilization conditions without sacrificing the optimum yield under optimum conditions. The higher yields result from more spikelets filled with heavier kernels, rather than an increase in the number of tillers in addition to a slight increase in protein content and reduced water consumption. Delaying the application of nitrogen until the tillering phase completing and the start of a new growth phase with a higher seeding rate lead to many stems, greater yield potential and more spikelets filled with grains.

References

A.A. Luma and M.H. Khaeim (2018). Utilization of Treated Wastewater in Irrigation and Growth of Jatropha Plant to Protect the Environment from Pollution and Combating Desetification. *Plant Archives*, **19(2):** 824-826.

Alawsy, W.S.A., L.A.S. Alabadi and H.M. Khaeim (2018). Effect of sewage water irrigation on growth performance, biomass and nutrient accumulation in maize and barley. *International Journal of Agricultural and Statistical Sciences*, **14(2):** 519-524.

Al-Baldawy, M.S.M., H. Ahed Abd Ali and H.M. Khaeim (2019). Antifungal Inhibitory Activity of *Thymus Vulgaris* L. and Artemisia Herba-alba Powder and its Constituent Phytochemicals Against Aspergillus Ochraceus and Fusarium Graminearum growth. *Plant Archives*, **19(1):** 801-804.

Jeber, B.A. and H.M. Khaeim (2019). Effect of foliar application of amino acids, organic acids and naphthalene acetic acid on growth and yield traits of wheat. *Plant Archives*, **19(2):** 824-826.

Khaeim, H.M. (2013). Mass selection with an optical sorter for head scab resistance in soft red winter wheat.

Khaeim, H.M., A. Clark, T. Pearson and D. Van Sanford (2019). Methods of Assessing Fusarium Damage to Wheat Kernels. *Al-Qadisiyah Journal For Agriculture Sciencesm* (*QJAS*)(P-ISSN: 2077-5822, E-ISSN: 2617-1479), **9(2):** 297-308.

Khaeim, H.M., A. Clark, T. Pearson and D. Van Sanford (2019). Determining The Effect of Mass Selection for FHB Resistance in Soft Red Winter Wheat Using an Image-Based Optical Sorter. *Al-Qadisiyah Journal For Agriculture Sciences,* (*QJAS*) (P-ISSN: 2077-5822, E-ISSN: 2617-1479), **9(2):** 278-296.

Khaeim, H.M., A. Clark, T. Pearson and D. Van Sanford (2019). Comparing Genetic Variation within Red Winter Wheat Populations with and without Image-Based Optical Sorter Selection. *Al-Qadisiyah Journal For Agriculture Sciences,* (*QJAS*) (P-ISSN: 2077-5822, E-ISSN: 2617-1479), **9(2):** 266-277.

Khaeim, H.M., B.A. Jeber and M.A. Ali (2019). Winter Wheat Genotypes Response to Different Water Quality. *Int. J. Agricult. Stat. Sci.*, **15(2):** 669-676.

Mariateresa Lazzaro, Paolo Bàrberi, Matteo Dell'Acqua, Mario Enrico Pè, Margherita Limonta, Delfina Barabaschi, Luigi Cattivelli, Paolo Laino and Patrizia Vaccino (2019). *Journal: Agronomy for Sustainable Development*, **39(1):** DOI: 10.1007/s13593-018-0551-1.

Navjot K. Dhillon, Satbir S. Gosal and Manjit S. Kang (2012). Page 23. DOI: 10.1002/9783527665334.ch2.

Panjang Guan, Lahu Lu, Lijia Jia, Muhammad Rezaul Kabir, Jinbo Zhang, Tianyu Lan, Yue Zhao, Mingming Xin, Zhaorong Hu, Yingyin Yao, Zhongfu Ni, Qixin Sun and Huiru Peng (2018). *Journal: Frontiers in Plant Science*, **9:** DOI: 10.3389/fpls.2018.00529.

Phillips, S.B., D.A. Keahey, J.G. Warren and G.L. Mullins (2004). Estimating Winter Wheat Tiller Density Using Spectral Reflectance Sensors for Early-Spring, Variable-Rate Nitrogen Applications. *Agron. J.*, **96:** 591-600. DOI:10.2134/agronj2004.0591.

Rui Wang, Yuxiu Liu, Kyle Isham, Weidong Zhao, Justin Wheeler, Natalie Klassen, Yingang Hu, J. Michael Bonman and Jianli Chen (2018). *Journal: Molecular Breeding*, **38(11):** DOI: 10.1007/s11032-018-0894-y.

Ruishi He, Yongjing Ni, Junchang Li, Zhixin Jiao, Xinxin Zhu, Yumei Jiang, Qiaoyun Li and Jishan Niu (2018). *Journal: International Journal of Molecular Sciences*, **19(5):** Page 1324. DOI: 10.3390/ijms19051324.

Xueling Ye, Yuqing Lu, Weihua Liu, Guoyue Chen, Haiming Han, Jinpeng Zhang,. Xinming Yang, Xiuquan Li, Ainong Gao and Lihui Li (2015). *Journal: Theoretical and Applied Genetics*, **128(5):** Page 797. DOI: 10.1007/s00122-015-2466-4.

Zhiqiang Wang, Yaxi Liu, Haoran Shi, Hongjun Mo, Fangkun Wu, Yu Lin, Shang Gao, Jirui Wang, Yuming Wei, Chunji Liu and Youliang Zheng (2016). *Journal: Theoretical and Applied Genetics*, **129(3):** Page 603. DOI: 10.1007/s00122-015-2652-4.