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Effect of Climate Variations in Bekaa on Bread Wheat Productivity , Grain Quality and banking Characteristics

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مقالة تحت الطبع في مجلة بعنوان تأثير اختلاف المناخ والموقع على
انتاجية ونوعية القمح الطري.

Effect of Climate Variations in Bekaa on Bread Wheat productivity, Grain Quality and Baking Characteristics.

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Abstract

Five new promising bread wheat genotypes in addition to a recently released variety "Tannour" and the local Lebanese landrace (Braiji) were evaluated for their productivity, grain and flour quality under different climatic conditions in the Bekaa plain namely West, Central and North Bekaa. Results showed that the highest grain yields and grain sizes were obtained in the Western Bekaa location where the long term average annual rainfall exceeds other Bekaa locations by at least 200 mm. Among the tested genotypes, Seri 82/Shuha'S' (515 kg/dn) and Seri 82/Vee'S'/Snb'S' (491 kg/dn) both significantly outyielded the Check "Tannour" (421 kg/dn) in the Central Bekaa location while Attila 417 and Seri 82/Shuha'S' had significantly bigger seed size than "Tannour" in all of the 3 Bekaa locations. Protein contents in seeds of the different genotypes were also affected by the location type and came out to be highest in Northern Bekaa (12.7%) and lowest in the Western Bekaa location (11%).Both Attila 417 and Seri 82/Vee'S'/Snb'S' had high protein contents in North Bekaa (more than 14 %) while the local landrace performed better in the other locations . All of these genotypes were superior to the check "Tannour" in all 3 locations. Grain hardness ranged from soft to very hard depending on genotype and location. While some genotypes such as Seri 82/Vee'S'/Snb'S' were classified as hard irrespective of the locations, the landrace "Braiji" was more suitable for drier Bekaa conditions and gave softer grain under wetter conditions such as those prevailing in the western part of the valley. The hardness of all other genotypes was slightly affected by location. Farinograph mixing tolerance was best for Seri 82/Shuha'S' which showed good mixing tolerance under all tested climates contrary to the others which had a mixing tolerance that ranged between weak to medium depending on genotype and location. Seri 82/Shuha'S' also had medium farinograph stability time when all other genotypes were mostly classified weak to very weak . Attila 417 and Seri 82/Vee'S'/Snb'S' were mostly affected by climate, they were mostly suitable under Central Bekaa conditions where they had medium stability time.

Keywords: Bread wheat, grain quality, flour quality, climate

تأثير اختلاف المناخ في سهل البقاع على إنتاجية ونوعية حب القمح الطري وخصائص عجينه

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ملخص

تم في هذه الدراسة تقييم بعض الأصناف الجديدة من القمح الطري من حيث إنتاجية الحب ونوعيته وخصائص الطحين والعجين ، وذلك تحت ظروف مناخية متنوعة في منطقة البقاع الشمالي والغربي والأوسط. دلت النتائج أن إنتاجية الحب وحجمه كانا الأفضل في موقع البقاع الغربي حيث تزيد معدلات الأمطار السنوية عن بقية المواقع ب 200 ملم على الأقل. وقد أعطت الأصناف 'Seri82/Shuha'S و 'Seri82/Vee'S'Snb'S وبشكل معنوي إنتاج حب أفضل من الشاهد "تتور" في موقع البقاع الأوسط بينما أعطت الأصناف Attila 417 و 'Seri 82/Vee'S'/Snb'S حب أكبر من الشاهد وبشكل معنوي أيضا في مواقع البقاع الثلاث. أما بالنسبة لمحتوى البروتين في الحب، فتأثرت بالمناخ والموقع وكانت الأعلى في البقاع الشمالي (12.7%) والأدنى في البقاع الغربي (11%) ، ووصل محتوى البروتين في البقاع الشمالي إلى 14 % للصنفين Attila 417 و 'Seri 82/Vee'S'/Snb'S بينما تفوق الصنف البلدي في المواقع الأخرى. وقد تراوح تصنيف الحب حسب قسوته من ناعم الى قاسي جداً وذلك حسب الصنف والموقع بينما أعطى الصنف 'Seri82/Vee'S'/Snb'S حب قاسي بغض النظر عن موقع زراعته. وكان البلدي أكثر ملائمة في الموقع الأكثر جفافاً كما أعطى حب أقل قسوة في موقع البقاع الغربي. أما بالنسبة لتحليل خصائص الطحين والعجين Farinograph، فقد أظهرت النتائج بأن الصنف 'Seri82/Shuha'S هو الأفضل من بين الأصناف المجربة بالنسبة إلى تحمل المزج Mixing tolerance تحت جميع الظروف المناخية البقاعية وبعكس بقية الأصناف التي بينت قدرة تحمل مزج متوسطة إلى ضعيفة حسب الموقع والصنف، وكان للصنف ذاته ثباتية فارينوغراف متوسطة بعكس بقية الأصناف التي تراوحت بين ثباتية ضعيفة إلى ضعيفة جداً ، وتأثرت الأصناف Attila417 و 'Seri82/Vee'S'/Snb'S بالموقع حيث كان لهم ثباتية فارينوغراف متوسطة في البقاع الأوسط.

Introduction

Bread Wheat in the WANA (West Asia and North Africa) region occupies an area of 17 million hectare , 77% of the area is rainfed, of which 7.3 million receive less than 400 mm annual rainfall (Yau and Ortiz-Ferrara 1991). In Lebanon, Wheat is cultivated on around 20,000 ha only, its production does not exceed 50,000 tons which makes around 10 % of the country's consumption needs. Only until recently that wheat production was mainly in favour of durum wheat. This is partly because of the absence of registered released bread wheat varieties but also because durum cultivation is easier due to its better tolerance to extreme weather conditions and better tolerance to rust diseases such as yellow rust and leaf rust.

However, the market demand for durum seeds is limited for making burghol and kishek since there is no pasta industry in the country and since durum wheat is not used in bread making flour mixtures. The greater market and mills demand necessitates more production of bread wheat seeds specially those with acceptable or good baking characteristics.

Being a part of the WANA region where large and significant Genotype X Site interaction has been reported (Yau et. al.,1991), Lebanon enjoys great variations in its climate, such variations can be also found within the Bekaa plain which is the major wheat growing area in the country.

Based on the above, the objective of this study was therefore, to evaluate several promising bread wheat genotypes for their productivity and grain and flour characteristics under different climatic conditions representing the major wheat growing areas in Lebanon.

Materials and Methods

Plant material and Locations

In addition to the released check "Tannour" and the local Lebanese landrace "Braiji", five additional improved genotypes from ICARDA were used in this experiment which was planted in 4 locations representing different climatic conditions as shown in Table 1.

Table 1. Locations description and names of used genotypes.

Genotypes	Location	Location Characteristics
Tannour (Check) Braiji (Local Landrace) Atila 417 Seri 82/Vee'S'/Snb'S' Tevee'S'/Vee'S'/Pvn'S' Seri 82/Shuha'S' Cham-2/Vee'S'	Jeb Jannin, West Bekaa	1000 m elevation, 700 mm average rainfall, low humidity and cold.
	Tel Amara, Central Bekaa	900 m elevation, 500 mm average rainfall, low humidity and cold.
	Iaat, North Bekaa	1000 m elevation, 350 mm average rainfall, low humidity, dry and cold.

Experimental Design

The experiment consisted of a Randomized Completely Block Design (RCBD) with 3 replications. Each experimental plot was 8 m^2 in area and included 8 rows, 20 cm apart and 5 meter long. The plots were planted by an experimental sowing machine manufactured by Wintersteiger.

Cultural Practices

All experiments were identical in their layout across all locations, they were all sprayed with 2,4-D MCPA herbicide to kill the broad leafed weeds and were fertilized with a total of 100 kgs. of pure nitrogen units per hectare, 35% of which was applied with planting as NPK (17-17-17) and the remaining 65% at tillering as ammonium nitrate.

Data Collection

The evaluation data included heading and maturity dates, plant height, grain yield and 1000 kernel weights. The seeds from each genotype in each location were cleaned and sent to the grain quality Lab at ICARDA for Farinograph analysis which was done as described by Williams and co-workers (1988).

Results and Discussions

As expected, results showed that the highest grain yields and grain sizes were obtained in the Western Bekaa location (Figures 1 and 2) where the long term average rainfall exceeds other Bekaa locations by at least 200 mm.

Data from Central and North Bekaa locations was comparable , in these drier locations, satisfactory grain yields were obtained due to supplementary irrigation, this agrees with the findings of Oweis and co-workers (1998) concerning supplementary irrigation research in the WANA region to which the Bekaa plain belongs.

Among the tested genotypes, Seri 82/Shuha'S' and Seri 82/Vee'S'/Snb'S' both significantly outyielded the Check "Tannour" in the Central Bekaa location (Table 2) On the other hand, Attila 417 and Seri 82/Shuha'S' had significantly bigger seed size than "Tannour" in all of the 3 Bekaai locations.

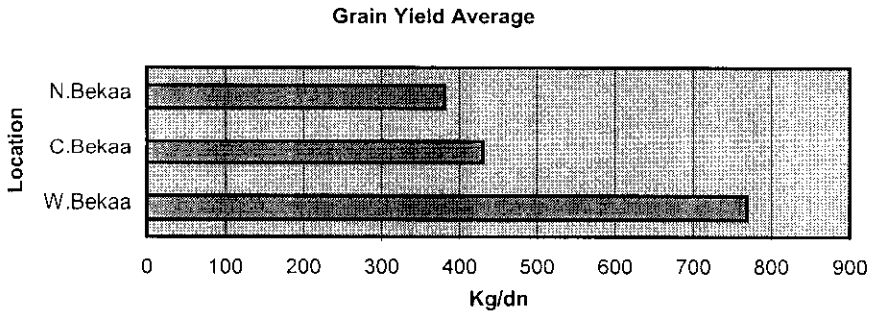

Figure 1. Average grain yield (kg/dn) of tested genotypes across locations.

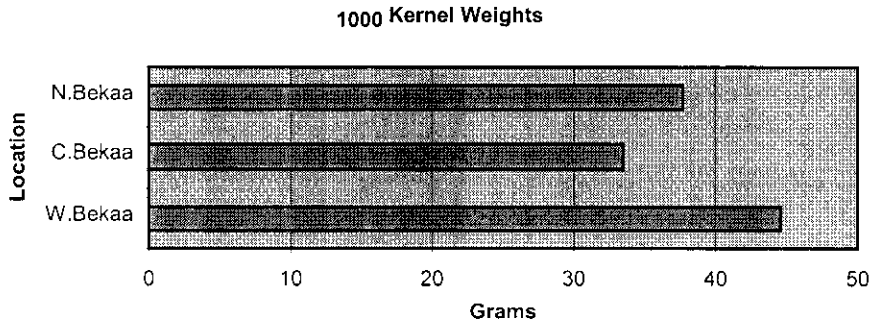

Figure 2. Average grain sizes (Wt. of 1000 grains) of tested genotypes across locations.

Table 2. Grain yields (kg/dn +/- St. deviations) and 1000 kernel wt. (grams) of tested genotypes in the 3 Bekaai locations.

Genotype		West Bekaa	Central Bekaa	North Bekaa
Tannour (Check)	GY	875 ± 88	421 ± 22	498 ± 67
	1000 KWT	39.7 ± 1.0	31.4 ± 0.2	36.9 ± 1.4
Braiji (Landrace)	GY	174 ± 35	242 ± 16	249 ± 56
	1000 KWT	36.1 ± 1.2	33.4 ± 1.3 *	32.9 ± 2.2
Attila 417	GY	818 ± 77	455 ± 17	291 ± 87
	1000 KWT	49.7 ± 1.4 *	36.9 ± 0.8 *	40.1 ± 3.4 *
Seri 82/Vee'S'/Snb'S'	GY	862 ± 131	491 ± 64 *	312 ± 77
	1000 KWT	48.3 ± 2.1 *	35.4 ± 0.7 *	39.4 ± 3.4
Tevee'S'Vee'S'/Pvn'S'	GY	906 ± 42	455 ± 44	470 ± 104
	1000 KWT	47.0 ± 6.3 *	31.6 ± 0.4	36.6 ± 3.1
Seri 82/Shuha'S'	GY	883 ± 128	515 ± 64 *	440 ± 115
	1000 KWT	48.6 ± 2.6 *	36.4 ± 1.6 *	42.6 ± 2.7 *
Cham 2/Vee'S'	GY	864 ± 64	431 ± 38	410 ± 114
	1000 KWT	42.9 ± 0.6 *	29.6 ± 1.6	35.1 ± 0.6

** Significantly better than the check "Tannour" at the 5% prob. level.*

Heading and Maturity were most rapidly reached in Central Bekaa as compared to the other locations, but highest plants were recorded as expected under the wetter Western Bekaa conditions (Figure 3).

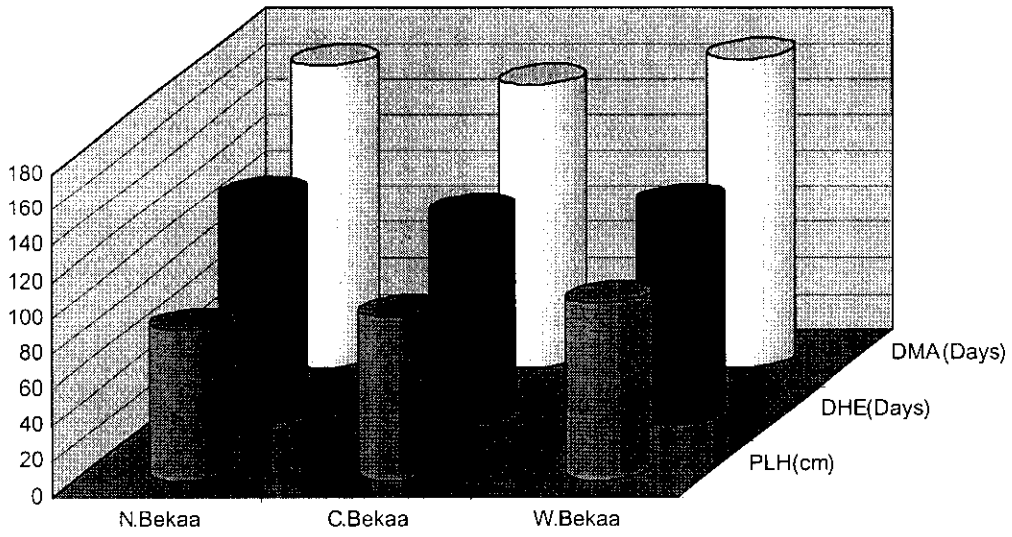

Figure 3. Heading, maturity and plant heights of tested genotypes across locations.

Protein contents in seeds of the different genotypes was also affected by the location type and came out to be highest in Northern Bekaa (12.7%) and was as expected lowest in the Western Bekaa location where grain yields and grain sizes were highest , this shows a negative relation present between these characters and protein content (Figure 4).

Attila 417 and Seri 82/Vee'S'/Snb'S' had high protein contents in North Bekaa (more than 14 %) while the local landrace performed better in the other locations (Table 3). All of these genotypes were superior to the check "Tannour" in all 3 locations.

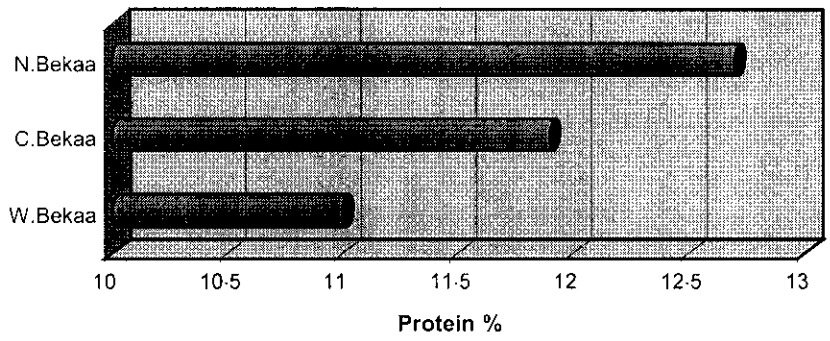

Figure 4. Seed protein contents of tested genotypes across locations.

As for grain hardness, it ranged between soft to very hard depending on genotype and location. While some genotypes such as Seri 82/Vee'S'/Snb'S' were classified as hard irrespective of the locations, the landrace "Braiji" was more suitable for drier Bekaa conditions and gave softer grain under wetter conditions such as those prevailing in the western part of the valley. The hardness of all other genotypes was slightly affected by location (Table 3) specially the released check Tannour whose hardness was not the same across all 3 locations.

For the farinograph analysis, the results obtained showed acceptable water absorption percentages for all genotypes but to a lesser extent for the local landrace. However, the farinograph mixing tolerance was best for Seri 82/Shuha'S' which showed good mixing tolerance under all tested climates contrary to the others which had a mixing tolerance that ranged between weak to medium depending on genotype and location. Seri 82/Shuha'S' also had medium farinograph stability time while all other genotypes were mostly classified weak to very weak .

Attila 417 and Seri 82/Vee'S'/Snb'S' were affected by locations and were mostly suitable under Central Bekaa conditions which improved their stability time from very weak to weak and medium.

The tested genotypes had very weak to medium development time, while the check Tannour, Tevee'S"/Vee'S'/Pvn'S' and Cham 2/Vee'S" were all classified as genotypes with medium development times irrespective of the location.

Table 3. Farinograph analysis of tested genotypes from the 3 different locations.

West Bekaa

Genotype	Protein %	PSI %	FAB %	FDT	FST	FMT
Tannour (Check)	10.5	Hard	63	Medium	Weak	Medium
Braiji (Landrace)	12.2	Soft	57	Very Weak	Weak	Weak
Attila 417	11.6	Hard	67	Weak	Very Weak	Weak
Seri 82/Vee'S'/Snb'S'	11.4	Hard	66	Weak	Weak	Weak
Tevee'S'Vee'S'/Pvn'S'	10.9	Hard	65	Medium	Weak	Medium
Seri 82/Shuha'S'	10.2	Hard	62	Weak	Medium	Good
Cham 2/Vee'S'	10.2	Hard	63	Medium	Weak	Medium
Location Average	**11.0**	**Hard**	**63**	**Weak**	**Weak**	**Medium**

Central Bekaa

Genotype	Protein %	PSI %	FAB %	FDT	FST	FMT
Tannour (Check)	11.6	Very Hard	64	Medium	Weak	Medium
Braiji (Landrace)	12.8	Medium	58	Very Weak	Weak	Medium
Attila 417	12.2	Hard	66	Weak	Very Weak	Medium
Seri 82/Vee'S'/Snb'S'	11.3	Hard	64	Weak	Weak	Medium
Tevee'S'Vee'S'/Pvn'S'	12.7	Medium	68	Medium	Weak	Medium
Seri 82/Shuha'S'	11.0	Hard	62	Weak	Medium	Good
Cham 2/Vee'S'	11.8	Hard	64	Medium	Weak	Medium
Location Average	**11.9**	**Hard**	**64**	**Weak**	**Weak**	**Medium**

North Bekaa

Genotype	Protein %	PSI %	FAB %	FDT	FST	FMT
Tannour (Check)	12.2	Medium	64	Medium	Weak	Medium
Braiji (Landrace)	12.5	Medium	56	Weak	Weak	Medium
Attila 417	14.6	Medium	66	Weak	Very Weak	Weak
Seri 82/Vee'S'/Snb'S'	14.3	Hard	65	Weak	Very Weak	Weak
Tevee'S'Vee'S'/Pvn'S'	12.0	Medium	65	Medium	Weak	Medium
Seri 82/Shuha'S'	12.1	Medium	60	Weak	Medium	Good
Cham 2/Vee'S'	11.4	Medium	63	Medium	Weak	Medium
Location Average	**12.7**	**Hard**	**63**	**Weak**	**Weak**	**Medium**

PSI= Particle Size Index, FAB= Farinograph Water Absorption, FDT= Farinograph Development Time, FST= Farinograph Stability Time, FMT= Farinograph Mixing Tolerance.

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References

Yau, S.K. and Ortiz-Ferrara, G. 1991. Cluster analysis of bread wheat growing sites in West Asia and North Africa. *Rachis*. V 10,(No.2): 28-32.

Yau, S.K. ; Ortiz-Ferrara, G. and Srivastava, J.P. 1991. Classification of diverse bread wheat growing environments based on different yield responces. *Crop Science*. 31 (3): 571-576

Williams, P.; Jaby El-Haramein, F.; Nakkoul, H. and Rihawi, S. 1988. Crop Quality Evaluation Methods and Guidelines. ICARDA's Technical Manual 14, Aleppo, Syria , 145 pp.

Oweis, T.; pala, M. and Ryan, J. 1998. stabilizing rainfed wheat yields with supplementary irrigation and nitrogen in a Mediterranean climate. *Agronomy Journal*. V 90 (5): 672-681.