Abu Dhabi Food Control Authority
Development Sector
Research & Development Division

Technical Report تقرير فني

Title العنوان	**Evaluation the Production of Wheat Genotypes under the UAE Condition**			
Project Team فريق العمل	Dr. Ihsan Abu Al-rub and Eng. Ahmed Aran			
Duration فترة المشروع	**From:**	July 2012	**To:**	July 2013

Background خلفية عن الموضوع

Wheat (*Triticum aestivum*) is a major food source for a large proportion of the world's population. Wheat is a widely adapted crop. It is grown from temperate, irrigated to dry and high-rainfall areas and from warm, humid to dry, cold environments (Acevedo, 2002). The UAE, with about 150 mm of average annual rainfall, is located in the dry part of the world. In such arid regions, irrigated farming is often practiced for all crop production. In these areas, the low soil moisture is identified as a major limiting factor for crops including wheat production.

Since the 1950s, the wheat breeding programs of the International Maize and Wheat Improvement Centre (CIMMYT) have played a key role in developing improved germplasm (Ortiz et al., 2008). Their high-yielding wheat lines for developing countries were particularly recognized for their role in the widespread adoption of semi-dwarf wheat and developments in disease resistance (Reynolds and Borlaug, 2006). CIMMYT lines are widely grown in developing as well as developed countries, for instance, 98% of the total Australian wheat area was sown to cultivars with CIMMYT ancestry in their pedigree in 2003 (Brennan and Quade, 2006).

Genetic progress for yield has been assessed globally in the semi-arid wheat yield trials (SAWYTs) of the International Maize and Wheat Improvement Center (CIMMYT) over a 17-yr period (Manès et al., 2012). Grain yield expressed as a percentage of the long-term check cultivar Dharwar Dry has increased at approximately 1% yr^{-1} between 1994 and 2010. In real terms, yield has been increased at a rate of 31 kg ha^{-1} yr^{-1}. The CIMMYT database indicated that mean grain yield at different international location ranged from 0.8 to 12.7 t ha^{-1} for Elite Spring Wheat Yield Trial (ESWYT) and from 0.6 to 8.2 t ha^{-1} for Semi Arid Wheat Yield Trial (SAWYT) (Gutierrez et al., 2011).

Selecting cultivars capable of coping with the local environmental conditions is the first and most important management decisions. Yield selection is empirical due to low heritability and a high genotype–environment interaction (Reynolds et al. 1999). It also requires the evaluation of a large number of advanced lines in field yield trials over several years and locations (Leila et al., 2013). For effective selection, information on nature and magnitude of variation in population, knowledge of correlation among such traits, their contributions towards grain yield and the extent of environmental influence on the expression of these characters are necessary (Yagdi, 2009).

Problems التحديات

- Lack of well adapted bread wheat genotypes in the UAE.

Objectives الأهداف

- Perform an evaluation study of CIMMYT spring wheat germplasm in relation to the benchmark cultivar and common checks.
- Provide data of varieties adaptability to the local environment, yield potential, disease and pest incidence.

Methods طريقة العمل

Field experiment:

The field trial was carried out at Al-Salamt Research Station in Al Ain City, UAE during the 2012-2013 growing season. Field trial was planted on 7th November, 2012. 98 CIMMYT wheat germplasm versus 5 modern cultivars were tested using Alpha Lattice design with two replications. The plot sizes were 3x3 m and consisted of 6 rows. The sowing rate was 100 kg ha^{-1}.

All plots were fertilized prior to planting with manure at a rate of 30 t ha^{-1}. Chemical fertilizers were applied once per week via irrigation at a rate of ٢00 kg N/ha, 120 kg P_2O_5/ha and 80 kg K_2O/ha. All plots were irrigated daily using evapotranspiration (ET_o) multiplied by crop factor (K_c). The estimated daily average of irrigation was about 4.15 L/m^2/day and continued for 119 days. The salinity of irrigation water was approximately 3500 ppm.

The plots were harvested manually at full maturity from 6th to 27th March 2013, and were threshed immediately after, as the plants were completely dried.

The aphids were controlled by spraying Mospilan at a rate of 4 g/20 L water, and Confidor at a rate of 20 cm^3/20 L water. Weeds were controlled manually.

Plant measurements:

- Grain Yield: The 4 centre rows of each plot were harvested manually (t ha^{-1}).
- 1000-grain weight expressed in grams.
- Lodging: The number of broken stalks was determined using a percentage scale. The 0% value indicates fully upright plants and 100% indicates completely lodged plants
- Days to heading: 50% of the plants in each plot were fully headed.
- Days to harvest: 100% of the spikes were ripe.
- Plant height: The height of the main tiller from ground to the tip of the spike excluding awns was measured on 5 random plants for each plot when the grain was beginning to form.
- Spike length expressed in cm.
- Agronomic score: it is 0-5 scale which evaluates the phenotypic development based on the appearance, 5 indicate the best and 0 the poorest unacceptable phenotype.
- Disease resistant rating: was scored according to CIMMYT standardized scoring scales for foliar disease.
- Protein analysis for the best 20 genotypes.

Plant Materials:

The study included 49 advanced lines derived from the international trial 33rd Elite Spring Wheat Yield Trial (ESWYT) and 49 lines derived from 20th Semi Arid Wheat Yield Trial (SAWYT) obtained from the CIMMYT Genetic Resource Centre. The ESWYT includes advanced breeding lines that are targeted for irrigated environments in the world. The SAWYT includes advanced lines for semi-arid regions. One commercial

cultivar used as a check in the two trials (Yacuru Rojo) from Elite Agro LL. which used intensively in the UAE. Additionally, the study included 4 Omani cultivars: Humaria, Qraiat 110, Qraiat 225, Qraiat 226.

Statistical analysis

Data collected from each trial were analysed using the Statistical Analysis System (SAS) following the Lattice Procedure (PR^{OC} LATTICE). Simple statistics, such as mean, standard deviation, ranges and coefficient of variation were calculated.

Results النتائج

20th Semi Arid Wheat Yield Trial (SAWYT):

The means of the genotypes generally displayed considerable differences between the minimum and maximum values for most of the traits evaluated (Table 1). The most interesting differences were observed in grain yield (4.5-8.83 t ha^{-1}), 1000-grain weight (42.2-63.6 g), plant height (73-108 cm) and spike height (7-12 cm), where the genotypes exhibited the widest range of values. Most of the measured traits, except lodging showed low coefficient of variation.

Table 1. Mean, standard deviation (S.D), range and coefficient of variation (C.V) for morphological and development traits of SAWYT.

Traits	Mean	S.D	Range	C.V
Grain yield (t ha^{-1})	6.76	0.93	4.5-8.83	11.5
1000- grain weight (g)	52.86	3.94	42.2-63.6	4.9
Plant height (cm)	92.99	8.05	73-108	2.0
Spike length (cm)	9.82	0.92	7-12	1.5
Lodging (%)	0.74	2.94	0-20	2.8
Days to heading	60.39	2.63	54-66	2.3
Days to harvest	130.5	3.85	123-137	2.7
Agronomic score	4.25	0.62	3-5	2.3

The analysis of variance for different morphological characters demonstrated an important variation among semi arid wheat genotypes. Most of the entries produced significantly higher grain yield than the commercial check.

Entry number 335 gave the highest grain yield (8.67 t ha^{-1}) followed by fourteen entries ranging from 7.17 to 8.08 t ha^{-1} (Table 2). The morphological traits of these entries displayed variation in term of plant height, spike length, days to heading and days to harvest. Half of these entries produced long plant (above 100 cm) and the others had moderated plant height. Most of these entries produced long spike above 10 cm.

The agronomic score of the highest yielded entry varied from 4 to 5. The best entries were 304, 310, 312, 323, 324, 335, 338, 344 and 347. The highest lodging percentage (15%) was observed in entry number 336 and it produced the second highest grain yield. There was no considerable disease infection or insect damage for all trials throughout the growing season.

Table 2. Mean Grain yield and different morphological traits of top genotypes of the SAWYT during 2012-2013 growing season.

Entry Number	Grain yield (t ha^{-1})	1000- grain weight (g)	Plant height (cm)	Spike length (cm)	Lodging (%)	Days to heading	Days to harvest	Agronomic score
Check	6.17	50.5	86	9	0	57	126.5	3
304	7.50	56.6	85	8	0	60	126.0	5
310	7.75	52.3	85	12	0	63	132.5	5
312	7.33	56.7	108	10	0.5	64.5	132.0	5
313	7.75	54.0	103	10	0.5	60.5	128.5	4
323	8.09	45.8	101.5	11	1	62	132.5	5
324	7.59	45.3	104.5	10	1.5	64	131.5	5
326	7.59	52.4	100.5	10.5	2	60	132.0	4
327	7.34	54.0	84.5	10	0	65	128.0	4
328	7.58	54.1	82.5	11	0	64	132.0	4
334	7.50	50.1	93.5	9	0	63	131.5	4
335	8.67	56.4	101.5	10	0	64	132.5	5
336	8.00	57.1	101	9	15	61	132.0	4
338	7.59	60.4	93	9	0	61.5	133.5	5
344	7.17	52.8	97	10	0	60.5	133.5	5
347	7.83	51.0	107	10	1	62.5	135.0	4

33rd Elite Spring Wheat Yield Trial (ESWYT):

The wheat genotypes tested in the ESWYT for irrigated conditions showed variable grain yield and other agronomic characteristics, with opportunities for selection of high yield and acceptable agronomic characters (Table 3). The genotypes exhibited the widest range of grain yield (3.3-8.67 t ha^{-1}), 1000-grain weight (40.9-66.6 g), plant height (75-104) and spike height (5-12 cm). In comparison to SAWYT, the ESWYT exhibited lower grain weight, shorter plant and spike, shorter duration to harvest and lower agronomic score.

Wheat genotypes used in ESWYT exhibited highly significant variation for grain yield and all other morphological traits (Appendix 2). The CIMMYT germplasm exhibited a higher range of grain yield as compared to the check. Despite that entries number 104, 115, 118 and 132 produced significantly high grain yield they were excluded due to their low agronomic score.

The result revealed that entry number 118 produced the highest significant yield of 8.17 t ha^{-1} followed by 114, 120, 129, 134 and 146 (Table 4). These entries were characterised by moderate plant height (< 100 cm) and spike length of 10 cm with low lodging percentage. The 1000-kernel weight was lighter than other entries with higher agronomic score.

Table 3. Mean, standard deviation (S.D), range and coefficient of variation (C.V) for morphological traits of ESWYT.

Traits	Mean	S.D	Range	C.V
Grain yield (t ha-^{1})	6.39	1.22	3.33-8.67	15.2
1000- grain weight (g)	52.67	5.13	40.9-66.5	6.3
Plant height (cm)	91.37	7.07	75-104	1.3
Spike length (cm)	9.9	1.06	5-12	6.5
Lodging (%)	0.89	1.87	0-5	2.4
Days to heading	59.75	2.98	44-66	1.0
Days to harvest	125.3	4.19	119-140	2.8
Agronomic score	3.94	0.82	2-5	3.5

Table 4. Mean Grain yield and different morphological traits of ESWYT during 2012-2013 season.

Entry Number	Grain yield (t ha^{-1})	1000- grain weight (g)	Plant height (cm)	Spike length (cm)	Lodging (%)	Days to heading	Days to harvest	Agronomic score
Check	4.33	49.1	82	8.5	5	45	122.0	2
107	7.00	54.1	99	11	4	60.5	122.5	4
114	8.09	52.3	99	10.5	0	61.5	126.0	4
116	7.00	53.8	93	10.5	2.5	60.5	122.5	4
120	8.00	48.5	95	10	0	60.5	130.5	4
121	8.17	50.6	99	10.5	2.5	62	125.5	5
127	7.25	59.1	83	10	0	57	122.0	4
128	6.92	54.6	102	11.5	2.5	60.5	127.5	5
129	8.00	45.8	92	9.5	0	59	130.0	4
131	6.42	49.6	99.5	10	5	62	123.0	5
134	8.08	49.1	91.5	10.5	0	60	130.5	5
139	7.92	54.6	92.5	10	0	60	124.5	5
140	7.42	47.3	98	9.5	2.5	61.5	130.0	5
142	7.00	50.5	94	10	0	59	126.5	5
143	6.67	54.6	92	11.5	0	59	124.5	5
145	6.59	54.2	87.5	10	0	60	124.5	5
146	8.00	45.5	98	10	0	60.5	130.5	5

Omani varieties:

The result indicated that the Omani varieties showed lower grain yield (4.5-5.3 t ha^{-1}) compared to ESWYT and SAWYT. The kernels were fine and narrow and 1000-grain weight did not exceed 40 g for all cultivars. Humaria produced very long plant (129 cm) which led to severe lodging condition; additionally it was characterized by a short awnless spike. The other cultivars were shorter with longer awnless spike and lower lodging percentage. All Omani varieties had longer duration to harvest and a got lower agronomic score.

Table 5. Mean Grain yield and different morphological traits of Omani varieties during 2012-2013 season.

Entry Number	Grain yield (t ha^{-1})	1000- grain weight (g)	Plant height (cm)	Spike length (cm)	Lodging (%)	Days to heading	Days to harvest	Agronomic score
Humaria	4.7	33.9	129.25	5.75	78.7	65.75	135	2
Qaret110	5.1	36.8	84.5	9	6.2	61.75	135	3
Qaret225	4.5	38.4	89.5	10	7.5	61.5	135	3
Qaret226	5.3	39.7	95.75	9.75	5	62	135	3
Mean	4.9	37.2	99.7	8.6	24.3	62.7	135	2.8
LSD	1.7	4.2	2.9	0.88	6.1	0.8	ns	0.4

Protein Analysis:

The wheat protein content was analysed for the 10 best lines of each trial (Table 6). The result showed a slight variation in protein content for all lines. The ESWYT exhibited a range (11.04- 13.74%) whereas entry number 127 have the highest protein content of 13.74%.

The same pattern was observed in SAWYT where the protein content range (10.9-12.74%) exhibited slight variation between lines. In general, the grain of wheat commonly contains protein that ranges in concentration from 8 to 15% (Johnson,. et al. 1985).

Table 6. Wheat Protein content analysis for the best lines.

ESWYT		SAWYT	
Entry Number	Protein content %	Entry Number	Protein content %
310	12.74	114	11.04
313	12.28	120	11.74
323	12.16	121	11.95
324	11.73	127	13.74
326	10.90	129	11.91
328	11.38	134	12.58
335	11.66	139	12.18
336	12.17	140	12.31
338	12.66	142	11.70
347	11.87	146	12.69

Recommendations التوصيات

- The CIMMYT genotypes provide options for identifying and released improved varieties for the region
- The first year screening revealed that the best entries from 20th SAWYT are 304, 310, 312, 323, 324, 335, 338, 344 and 347 and from 33rd ESWYT are 114,118, 120, 129, 134 and 146. These entries will be included for the second year evaluation.
- The grain yield of the best entries of 33rd ESWYT ranged (7-8.67 t ha^{-1}) and for 20th SAWYT (7.17-8.83 t ha^{-1}), which is higher than the common check (3.5-4 t ha^{-1}).
- The CIMMYT genotypes exhibited a higher range of grain yield and better plant traits compared to Omani cultivars, therefore Omani varieties will be excluded from the second year evaluation.
- There was no considerable disease or insect damage for all trials throughout the growing season 2012-2013.
- Beneficiaries: Agriculture Affaire Sector, Farmers' Service Centre, Farmers.

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