

SHANDAWEEL-6: A RECENTLY RELEASED GRAIN SORGHUM HYBRID FOR EGYPT

**O. O. El-Nagouly, M. S. A. Mostafa, M. I. Bashir, M. M. El Menshawi,
A. M. El-Kady, M. R. Asran and M. H. El Bakry**

Grain Sorghum Dept., Field Crops Research Institute
Agricultural Research Center, Giza, Egypt

ABSTRACT

Shandaweel-6 is a grain sorghum hybrid between the male-sterile line 631 and the restorer line no. 1 selected from the variety Dorado. Results of nine on-station yield evaluation trails at 3 different locations during 3 successive years, and twenty-three verification trails at 23 different locations in Upper Egypt showed that Shandaweel-6 has a high yielding potential ranging from 21.0 to 27.3 ard/fed (7.0 to 9.1 t/ha) at the station trails and from 16.48 to 20.8 ard/fed (5.49 to 6.93 t/ha) in farmers' fields. The hybrid has a medium plant height (170-200 cm), medium flowering date (70-77 days), long panicle (35-38 cm), semi compact head with long exersion, white bold kernels (30-35 gm/1000 kernels), straw-color glumes, resistant to downy mildew, leaf blight, stalk rot and long smut disease and with stay green and juicy stalks and leaves after physiological maturity. It can be planted at a high population density of 50-60 thousand plants/feddan. The hybrid was released for commercial production in 2000.

Key words: *Variety Release, Grain Sorghum*

INTRODUCTION

The discovery of cytoplasmic genetic male sterility in grain sorghum by Stephens and Holland in 1954 (Doggett 1969) made the production of grain sorghum hybrids more feasible and enabled plant breeders to utilize the hybrid vigor expressed by diverse sorghum genotypes.

Grain sorghum hybrids, compared to pure varieties have the advantage of being more uniform in maturity and plant height and greater stability to fluctuation in growing environmental conditions and management levels (Murty *et al* 1994 and Rao 1972).

Doggett (1969) pointed out that grain sorghum hybrids can yield twice or more than pure varieties. Heinrich *et al* (1983) showed that stable hybrids were higher yielding in poor environments.

The development of hybrid sorghum in Egypt started in 1990 through the cooperation with the international organizations such as the International Sorghum and Millet Collaborative Research Support Program (INTSORMIL) and the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), and the first two hybrids Shandaweel-1 and Shandaweel-2 were released for commercial in 1996 (El Nagouly *et al* 1997).

The release of a hybrid depends on its performance, yielding ability, kernel size and quality and resistance to major diseases in multi-location replicated yield trails. Doggett (1970) pointed out that use of two replicates at several sites is more effective than several replications at a single site.

Rao (1972) stated that genetic superiority over a large number of locations even during a single year could enable the earlier release of new hybrids or varieties and shorten the time and effort of testing. Kambal and Mahmoud (1978) also suggested that the years of testing could be reduced by increasing the number of test locations

The target of the national grain sorghum improvement projects is to increase grain production via increasing yield per unit area and expanding the area planted with high yielding hybrids. This requires a sustained strong breeding program efforts. On going research is being focused on selecting materials for hybrid development program to enable the release of hybrids characterized by high yielding potential under variable environmental stresses, particularly water and nutrient shortages.

The study reported here resulted in the release of the hybrid Shandaweel-6 which is adapted to Egyptian conditions, has a high yielding potential and desirable grain quality for local sorghum growing farmers.

MATERIALS AND METHODS

Developing grain sorghum hybrids requires continued efforts to identify hybrids which can outyield current varieties in grain yield, stability, its resistance to major biotic and abiotic stresses. To realize these objectives, the following steps are followed:

- 1-Screening and evaluating parental lines: A large number of exotic cytoplasmic-genetic male-sterile and restorer lines are screened for adaptability to Egyptian conditions, resistance to major diseases, agronomic performance, grain quality (grain size and color) and yield potential. Several adapted lines were identified. These lines were tested for combining ability in hybrid combinations and a limited number of lines showing good combining ability were selected.
- 2-Experimental hybrid seed production: The chosen restorer and male-sterile lines were crossed to produce sufficient hybrid seed to evaluate potential yield, stability and resistance to major diseases at different locations for several years.

Evaluation trails, start with preliminary field observation trails, then the promising hybrids are tested in three levels of the on-station yield evaluation trails (A, B and C levels). The outstanding hybrids which pass the three levels of the on-station trails are tested in farmer's fields (D-level trails). Six hybrids including Shandaweel-6 along with the two previously

released hybrids (Shandaweel-1 and 2) and variety Dorado were evaluated for yield and other traits in three successive years (1996, 1997 and 1998). Prior to release, the hybrid, Shandaweel-6, was compared with other released hybrids (Mina, Horas, Shandaweel-1 and Shandaweel-2) in large scale on farm trails across seven Governorates in Upper Egypt in 1998. The Randomized Complete Block Design with four replications was followed in all evaluation trails. Plot size was two rows of four meters long for the on-station yield trails. For the D- trails, plot size was 6 rows, 6 meters long. Data for the on-station trails were recorded for days to 50 % heading, plant height, 1000-kernel weight and grain yield/plot. Recommended cultural practices were followed and plant protection operations were done as needed. Data were statistically analyzed according to standard statistical procedures (Steel and Torrie 1980).

RESULTS AND DISCUSSION

Grain yield of a hybrid is the end product of many yield contributing factors, including plant height, days to maturity, head length, head width, number of kernels/head, kernel size, disease and insect reaction and adaptability to environmental fluctuations which determine the stability of yield across experimental locations and seasons. Therefore data reported herein are based on grain yield across different locations in three successive years, to satisfy the multilocation test requirements suggested by Doggett, 1970; Kambal and Mahmoud (1978) and Rao (1972). Other features of the tested hybrids were recorded and considered in hybrid choice.

The average grain yield of the hybrid Shandaweel-6 at each location in the 3 successive years along with its characteristics in comparison with other hybrids and check variety Dorado are shown in Tables (1, 2 and 3). Combined data across locations in each year are presented in Table (4).

In 1996 season, Shandaweel-6 ranked first in terms of grain production at Shandaweel, Fayoum and Sadat locations. Productivity of the Fayoum location was lower than other locations due to its inherent low production conditions. Although Shandaweel-6 (36.3 ard/fed) attained the highest grain yield at Shandaweel, it was not significantly different from Shandaweel-2 (36.1 ard/fed), Shandaweel-1 and Shandaweel-5 which ranked 2nd, 3rd and 4th, respectively (Table 1).

At Fayoum, Shandaweel-6 though had a low yield average (16.0 ard/fed), it was significantly higher yielding than other hybrids and the check variety Dorado. However, at Sadat both Shandaweel-6 and Shandaweel-2 had statistically similar yields (22.1 and 21.3 ard/fed, respectively), but both were significantly higher yielding than other tested hybrids (Table 1).

Table 1. Average grain yield and other traits of six grain sorghum hybrids at 3 locations, 1996.

Hybrid & Variety	50% flower (days)	Plant height (cm)	1000 kernels weight (gm)	Grain yield (ard/fed)	Rank
Shandaweel					
Shandaweel-1	71	151	35.5	35.6	3
Shandaweel-2	71	203	39.8	36.1	2
Shandaweel-3	65	191	39.5	28.6	6
Shandaweel-4	69	198	39.5	33.4	5
Shandaweel-5	71	203	43.5	35.4	4
Shandaweel-6	70	213	43.5	36.3	1
Dorado	72	148	47.5	28.2	7
Mean	70	186	41.3	33.3	
C.V. (%)	0.7	1.42	0.5	5.7	
L.S.D (0.05)	0.8	3.9	0.3	2.8	
Fayoum					
Shandaweel-1	73	103	36	13.2	4
Shandaweel-2	75	121	38	14.2	3
Shandaweel-3	70	112	35	10.5	5
Shandaweel-4	69	111	34	9.0	7
Shandaweel-5	72	119	37	14.4	2
Shandaweel-6	73	119	39	16.0	1
Dorado	73	122	36	9.5	6
Mean	72	115	36.4	12.4	
C.V. (%)	1.3	2.0	7.0	8.0	
L.S.D (0.05)	1.4	2.6	35.0	1.5	
Sadat					
Shandaweel-1	75	96	42	19.4	4
Shandaweel-2	77	119	43	21.3	2
Shandaweel-3	71	111	43	19.6	3
Shandaweel-4	70	106	37	16.7	5
Shandaweel-5	73	118	39	12.9	7
Shandaweel-6	75	118	42	22.1	1
Dorado	73	122	39	13.8	5
Mean	73	113	40.7	18.0	
C.V. (%)	1.0	2.0	4.1	7.1	
L.S.D (0.05)	1.1	3.0	3.0	2.0	

ardab = 0.15 ton.

Table 2. Average grain yield and other traits of six grain sorghum hybrids at 3 locations, 1997.

Hybrid & Variety	50 % flower (days)	Plant height (cm)	1000 kernels weight (gm)	Grain yield (ard/fed)	Rank.
Shandaweel					
Shandaweel-1	71	135	29.0	22.7	5
Shandaweel-2	68	175	31.3	23.1	4
Shandaweel-3	70	189	31.3	23.8	3
Shandaweel-4	71	169	30.0	29.8	1
Shandaweel-5	66	174	26.8	23.8	3
Shandaweel-6	68	189	29.4	26.4	2
Dorado	69	115	30.4	19.7	6
Mean	69	163.7	29.7	24.2	
C.V. (%)	1.5	5.2	1.0	6.3	
L.S.D (0.05)	1.5	12.6	0.4	2.2	
Fayoum					
Shandaweel-1	70	133	25.6	19.4	6
Shandaweel-2	70	173	30.3	23.7	2
Shandaweel-3	70	184	29.7	22.2	4
Shandaweel-4	70	186	27.9	22.8	3
Shandaweel-5	68	186	30.1	21.9	5
Shandaweel-6	71	188	31.8	26.1	1
Dorado	70	134	31.0	20.3	7
Mean	69.6	169.1	29.5	22.3	
C.V. (%)	1.4	1.3	3.7	3.4	
L.S.D (0.05)	1.4	3.1	1.5	1.1	
Nubarria					
Shandaweel-1	69	140	32.7	26.8	4
Shandaweel-2	69	183	30.8	28.8	2
Shandaweel-3	71	189	33.1	27.3	3
Shandaweel-4	70	184	30.3	26.0	5
Shandaweel-5	69	183	33.1	25.9	6
Shandaweel-6	71	193	36.0	29.4	1
Dorado	68	138	32.7	22.9	7
Mean	69.6	172	32.7	26.7	
C.V. (%)	15.5	2.0	10.4	2.9	
L.S.D (0.05)	15.4	5.0	0.5	1.1	

Table 3. Average grain yield and other traits of six grain sorghum hybrids at 3 locations, 1997.

Hybrid & Variety	50 % flower (days)	Plant height (cm)	1000 kernel weight (gm)	Grain yield (ard/fed)	Rank.
Shandaweel					
Shandaweel-1	66	168	32.2	33.9	3
Shandaweel-2	66	230	34.0	34.2	2
Shandaweel-3	67	245	32.1	35.7	1
Shandaweel-4	65	281	35.6	28.5	6
Shandaweel-5	68	233	35.3	32.3	4
Shandaweel-6	69	233	35.4	31.4	5
Dorado	66	158	34.1	27.3	7
Mean	67	221	34.1	31.9	
C.V. (%)	1.0	274	1.0	16.0	
L.S.D (0.05)	1.0	90	0.3	8.0	
Sids					
Shandaweel-1	70	158	33	26.2	2
Shandaweel-2	69	191	31	27.9	1
Shandaweel-3	69	190	28	23.9	5
Shandaweel-4	68	170	31	26.2	2
Shandaweel-5	70	178	34	24.7	4
Shandaweel-6	69	198	38	25.7	3
Dorado	69	128	26	21.0	6
Mean	69	173	32	25.1	
C.V. (%)	0.8	2.3	2.3	15.8	
L.S.D (0.05)	0.8	5.9	1.1	3.2	
South Tahrir					
Shandaweel-1	95	121	31.0	14.2	1
Shandaweel-2	92	135	34.0	14.0	2
Shandaweel-3	96	123	31.5	11.1	6
Shandaweel-4	93	139	32.0	13.8	3
Shandaweel-5	96	138	32.0	11.6	5
Shandaweel-6	94	130	30.3	12.3	4
Dorado	101	98	32.0	10.1	7
Mean	95	126	31.8	12.4	
C.V. (%)	3.4	11.0	4.0	16.6	
L.S.D (0.05)	5.0	20.4	1.7	3.1	

Table 4. Average grain yield and other traits of six-grain sorghum hybrids combined over 3 locations during three successive years (1996-1998).

Hybrid & Variety	50 % flower (days)	Plant height (cm)	1000 kernel weight (gm)	Grain yield (ard/fed)	Rank.
1996					
Shandaweel-1	73	117	37.8	22.7	3
Shandaweel-2	74	147	40.3	23.9	2
Shandaweel-3	69	138	39.2	19.5	6
Shandaweel-4	69	138	36.8	19.7	5
Shandaweel-5	72	146	39.2	20.9	4
Shandaweel-6	72	150	41.3	24.8	1
Dorado	72	130	40.8	17.1	7
Mean	72	138	39.4	21.1	
C.V. (%)	1.1	1.6	4.3	6.8	
L.S.D (0.05)	1.1	3.1	2.4	2.0	
1997					
Shandaweel-1	70	136	29.1	23.0	6
Shandaweel-2	69	168	30.8	25.2	3
Shandaweel-3	70	187	31.3	24.4	4
Shandaweel-4	65	179	29.4	26.2	2
Shandaweel-5	67	181	30.0	23.9	5
Shandaweel-6	70	190	32.4	27.3	1
Dorado	69	129	31.4	21.0	7
Mean	69	167	30.6	24.4	
C.V. (%)	8.9	3.3	2.2	4.4	
L.S.D (0.05)	2.2	4.5	0.5	0.9	
1998					
Shandaweel-1	77	149	31.6	26.2	2
Shandaweel-2	75	185	34.0	27.9	1
Shandaweel-3	77	186	27.3	23.9	6
Shandaweel-4	75	197	33.8	26.2	3
Shandaweel-5	78	183	33.7	24.7	5
Shandaweel-6	77	187	32.9	25.7	4
Dorado	79	128	33.1	21.0	7
Mean	77	173	33.0	25.1	
C.V. (%)	2.6	20.7	2.1	15.8	
L.S.D (0.05)	1.6	29.4	1.0	3.2	

In 1997, Shandaweel-6 ranked 2nd at Shandaweel and first at both Fayoum and Nubaria stations (Table 2), however, at Shandaweel, the hybrid Shandaweel-2 ranked first and was significantly higher yielding than all other hybrids. At Nubaria, both Shandaweel-6 and Shandaweel-2 were not significantly different. On the other hand, at Fayoum Shandaweel-6 had significantly higher yield than all other hybrids.

In 1998, although Shandaweel-6 ranked 5th, 3rd and 4th at Shandaweel, Sids and South Tahrir, respectively, its yield was not significantly different from all other hybrids (Table 3) showing higher yields at all locations. At South Tahrir location, due to poor fertility level and low water holding capacity, the productivity of the soil at this area was very low and differentiation among varieties or hybrids depends on tolerance to such conditions. The hybrids Shandaweel-1, 2, 4 and 6 were among those hybrids which can withstand such circumstances and attain satisfactory yield.

Combined data over locations (Table 4) show that Shandaweel-6 ranked first in 1996 and 1997 and was significantly higher yielding than all other hybrids except Shandaweel-2 which was not significantly different from Shandaweel-6 in 1996 season. In 1998, grain yield of Shandaweel-6 (25.7 ard/fed) ranked the 4th; however, it was not significantly different from that of Shandaweel-2, Shandaweel-1 and Shandaweel-4 which ranked 1st, 2nd and 3rd, respectively.

Productivity of Shandaweel-6 compared with the three other released hybrids viz. Mina, Shandaweel-2 and Horas sorghum hybrids in on-farm trails across 7 Governorates in Upper Egypt are shown in Table (5). The presented data show that Shandaweel-6 hybrid had a satisfactory yield compared with other released hybrids. However, it is worth noting that grain yield productivity of a given hybrid is not the only criterion for its release, but other features of economic value to growers such as grain color, kernel size, early maturity, tolerance to major diseases...etc. should be taken into consideration. Shandaweel-6 is characterized by several favourable characteristics in addition to its high yielding potential as compared with other released hybrids. These include medium plant height (170-200 cm); with stay-green and juicy stalks and leaves after physiological maturity, medium flowering date (70-77 days), long panicle (35-38 cm), semi-compact head with long exersion, white bold kernels (30-35 gm/1000 kernels), and resistance to downy mildew, leaf blight, stalk rot and long smut disease. It can be planted at a high population density of 50-60 thousand plants/feddan. Shandaweel-6 was released for commercial production in 2000.

Table 5. Productivity of the released hybrid (Shandaweel-6) compared with other released hybrids in observation field across 7 Governorates in Upper Egypt, 1998

Governorates	Sites	Grain yield (ard/fed)			
		Mena	Shand-2	Shand-6	Horas
Giza	El-Badrasheen	21.88	21.64	21.38	21.23
	El-Ayat	21.75	21.24	20.13	20.23
	Atfeih	20.56	20.69	20.88	20.08
	Mean	21.40	21.19	20.80	20.51
Bani Suif	El-Wasta	17.78	16.91	17.13	16.51
	Nasser	18.93	16.98	17.03	19.56
	Bani Suif	17.27	17.37	16.90	19.42
	Ahnasia	19.27	16.81	18.48	17.62
El-Fayoum	Mean	18.31	17.02	17.38	18.28
	El-Fayoum	20.37	17.26	17.08	21.17
	Sanorsa	20.37	17.08	16.21	19.27
	Tammia	20.09	16.64	16.34	19.49
	Ebshawi	18.07	17.74	16.15	19.84
	Esta	19.31	16.50	16.60	19.43
	Mean	19.71	16.84	16.48	19.84
Assiut	El-Kossia	21.60	20.91	21.41	21.34
	Manfalout	21.83	20.66	21.41	21.57
	Assiut	20.61	20.91	20.31	19.49
	Abnoub	20.67	21.44	19.17	21.46
	Mean	21.81	20.98	20.57	20.96
Sohag	Tema	21.38	21.15	21.37	21.20
	Gohainah	20.25	17.74	20.38	21.74
	El-Marghah	19.54	17.04	17.97	22.32
	Sohag	19.01	14.29	18.47	17.61
	Mean	19.30	18.31	19.55	20.74
Quena	Abotesht	20.72	20.39	17.99	20.85
	Quena	16.46	16.90	16.03	20.18
	Keft	20.62	21.66	17.25	21.04
	Mean	19.27	19.65	16.99	20.69

REFERENCES

- Doggett, H. (1969). Yields of hybrid sorghum. *Experimental Agric.* 5:1.
- Doggett, H. (1970). Sorghum. Longmans, London.
- El Nagouly, O. O., M. S. A. Mostafa, A. M. El Kady, M. I. Bashir, A. H. Ali and M. R. Asran (1997). Release of two new grain sorghum hybrids for Egypt. *Egypt. J. Agric. Res.*, 75 (4): 1007-1018.
- Heinrich, G. M., C. A. Francis and J. D. Eastin (1983). Stability of grain sorghum yield components across diverse environments. *Crop Sci.*, 23: 209-212.
- Kambal, A. E. and M. A. Mahmoud (1978). Genotype x environment interaction in sorghum variety tests in the Sudan general Rain Lands. *Agric.* 14: 41-48.
- Rao, N. G. P. (1972). Sorghum Breeding in India: Recent development. P. 101-142. In N. G. P. Rao and 2. R. Heuse (Eds). *Sorghum in the seventies*. Oxford and IBH Publishing Co. New. Delhi, India.
- Murty, D. S., R. Tabo and O. Ajayi (1994). Sorghum hybrid seed production and management. *Information Bulletin No. 41*. ICRISAT.
- Steel, R. C. D. and J. H. Torrie (1980). *Principles and procedures of statistics* 2nd ed. McGraw Hillco. New York, USA.

شندويل ٦ هجين ذرة رفيعة جديد للظروف المصرية

عثمان عثمان النجولى-محمد سامى عبد الفتاح-محمد ابراهيم بشير-

ميرفت مبرى المنشاوى-عزى مصطفى القاضى-محمد رزق الله عسران-محمد حسن البكرى

قسم بحوث الذرة الرفيعة-معهد بحوث المحاصيل الحقلية-مركز البحوث الزراعية-الجيزة

شندويل ٦ عبارة عن هجين بين السلالة البقيمة ٦٢١ والسلالة المعيدة للخصوبة رقم ١ الناتجة بالانتخاب من الصنف دورادو. أظهرت نتائج تسعة تجارب محصوليه على مستوى ٣ محطات بحثية مختلفة لمدة ثلاث سنوات متتابعة وكذلك نتائج ثلاثة وعشرون تجربة موسعة عند المزارعين فى ٢٣ موقع فى ٦ محافظات من الوجه القبلى تفوق محصول الحبوب لهجين شندويل-٦ مغنوبا أو تساويه حيث تراوح محصوله بين ٢١ إلى ٢٧,٣ أردب/فدان على مستوى المحطات البحثية ومن ١٦,٤٨ إلى ٢٠,٨ أردب/فدان عند المزارعين. ويتميز هذا الهجين بأنة متوسط الطول (١٧٠-٢٠٠ سم). وتظل أوراقه وسيقاته خضراء غضة وعصيرية بعد نضج الحبوب وغمد ورقة العلم وحامل النورة غير ملون ومتوسط التزهير (٧٠-٧٧ يوما) والتعديل طويل (٣٥-٣٨ سم) نصف مندمج وله حامل متوسط الطول-الحبوب كبيرة بيضاء (٣٠-٣٥ جم/١٠٠٠ حبة)-لون القنابع مثل لون القش-مقاوم للبياض الزغبي وتيقع الأوراق وعفن الساق والتفحم الطويل ويمكن زراعته بكثافة عالية من ٥٠ إلى ٦٠ ألف نبات/فدان. تم تسجيل هذا الصنف سنة ٢٠٠٠.

المجلة المصرية لتربية النبات ٥: ١١٧-١٢٦ (٢٠٠١).