Bull. Fac. Agric., Cairo Univ.,53
(2002): 1-20.

EARLY-GENERATION SELECTION FOR IMPROVED GRAIN FILLING IN WHEAT USING CHEMICAL DESICCATION

(Received: 17.6.2001)

By
M. M. Saadalla

Department of Agronomy, College of Agriculture, Alexandria University, Damanhoor, Egypt

ABSTRACT

Post-anthesis drought has a common drastic effect on wheat grain yield in arid and semi-arid regions, mainly through its deleterious effects on grain growth. Chemical desiccation has been proposed to simulate post-anthesis drought and to enable wheat breeders to select for tolerant genotypes in the field. This study was conducted to assess the effectiveness of early-generation selection for large kernels under chemical desiccation in six crosses of spring wheat (*Triticum aestivum* L.). Desiccation was applied 10 days after anthesis by spraying plants to full wetting with potassium iodide (0.4% w/v). Three cycles of mass selection for large grains were imposed on F_2, F_3, and F_4 generations in desiccated and non-desiccated plots. The selected seed bulks from the different cycles were tested collectively in the final season under both potential and post-anthesis drought conditions. Monitored response to selection showed that chemical desiccation combined with mass selection effectively improved kernel weight under post-anthesis drought, where a general trend of consistent increase in kernel weight was observed with advancing selection-response cycles. In contrast, selection pressure for grain filling under potential conditions (without desiccation) was non-effective in improving kernel weight under post-anthesis drought. However, selection for large kernels without desiccation was partially effective in increasing kernel weight when plants were tested under potential environment. Additionally, mass selection for large grains caused parallel responses in test weight and grain yield where selection for large grains under desiccation simultaneously improved kernel weight, test weight, and grain yield under post-anthesis drought. Furthermore, seed bulks selected without desiccation tended to have a relatively lower test weight and grain yield when subjected to post-anthesis drought comparing to bulks selected and tested under stress. The effectiveness of selection for large grains under desiccation was further confirmed by significantly less grain filling injury for the early-generation seed bulks selected under desiccation when tested under post-anthesis drought. Similar correspondent differences in test weight and grain yield injuries were observed among the tested seed bulks. The study demonstrated ample genetic variation among and within the studied crosses in the ability to utilize stem reserves in grain filling and the effectiveness of early-generation selection combined with chemical desiccation in identifying genotypes superior in kernel weight, test weight and grain yield.

Key words: *chemical desiccation, early-generation selection, grain filling, wheat.*

1. INTRODUCTION

Breeding for drought-tolerant wheat cultivars is a major objective in arid and semi-arid regions of the world due to inadequate precipitation, shortage of irrigation water, and high water demand for crop evapotranspiration in such climates. Additionally, the high water consumption during the vegetative stages of wheat growth, in these environments, frequently results in depleted soil water, which is required later for grain development. Therefore, post-anthesis water deficit is very often in such environments (Arraudeau, 1989). Hence, identifying plant traits that might stabilize wheat grain yield under post-anthesis drought has become a common objective for both wheat breeders and physiologists. Grain filling, particularly, is seriously affected by post-anthesis water deficit resulting in shriveled grains and drastically reduced grain yield (Saadalla, 1994a). This adverse effect of post-anthesis drought is mainly through hindered photosynthetic activities leading to shortage in assimilates required for grain growth (Boote *et al.*, 1994). Grain filling then increasingly depends on the contribution of vegetative reserves of assimilates that are remobilized mainly from plant stem to the developing grains (Davidson and Chevalier, 1992). Genotypic variation in plant capacity for grain filling from stem reserves, especially under stress, has been reported for wheat and other cereals (Nicolas and Turner, 1993; Blum *et al.*, 1997; Schnyder, 1993). However, identifying genotypes possessing high capacity for grain filling under field stress is handicapped by the erratic nature of field environments (Ceccarelli and Grando, 1996). Chemical desiccation has been proved to be effective as a simulator of post-anthesis drought stress where it ensures a plant deprivation from the transient photosynthesis, and therefore, has been used as a screening technique for post-anthesis drought tolerance under optimum field conditions (Ludlow and Muchow, 1990; Hossain *et al.*, 1990).

There are two opposing views on the genetic theory underlying selection for yield in early generations of crosses in self-pollinated crops. One view calls for delaying selection until reaching near homozygosity in late generations (Knott, 1972; McVetty and Evans, 1980). The opposing view assumes that the most desirable gene combinations can be identified even in the heterozygotes and the proportion of plants with these combinations decreases rapidly with advancing generations that might be lost if not selected in early generations (Rasmusson, 1987). However, several studies have reported success in selection among crosses using early generation testing (Singh *et al.*, 1990), while early-generations selection for yield within crosses has been frequently ineffective (Knott, 1972; Sneep, 1977). Therefore, many breeders and physiologists have proposed the use of some other simple traits, *i.e.* yield components, as yield-potential selection criteria in early generations rather than yield itself (Alexander *et al.*, 1984). Furthermore, potential improvement using early-generation mass selection within segregating crosses has been reported in cereals, *i.e.* for seed weight and high seed specific gravity in oat (Lanini and Marshall, 1990), for high specific gravity in wheat

(Derera and Bhatt 1974), and for large kernel size in wheat (Blum *et al.*, 1991; Saadalla, 1994b).

The effectiveness of mass selection in early generations by utilizing chemical desiccation still needs more elaboration where it could be a useful approach for improving grain-filling ability under post-anthesis stress. The objectives of this study were: i) to integrate the chemical desiccation technique into early-generation progeny selection of varying crosses, ii) to investigate whether mass selection for large kernels in chemically desiccated wheat bulks, comparing to non-desiccated, would lead to the improvement of grain filling under actual field drought stress, iii) to study the inter-relationships among grain filling capacity, grain yield, and test weight in early (F2-F5) selected wheat bulk populations.

2. MATERIALS AND METHODS

Six crosses of spring wheat (*Triticum aestivum* L.) were conducted by crossing Sakha 69 as a common female parent to each of Yecora Rojo, Newana, Canuck, Sakha 8, Giza 160, and Giza 155 (Table 1). Sakha 69 is an Egyptian cultivar with a high yielding potential, Yecora Rojo is a widely grown cultivar in Saudi Arabia, while Newana and Canuck are introductions from the USA with high tillering ability and are known to be relatively drought tolerant. The crosses were initiated in 1994/95 season in a private farm near Tanta City (30° 41' N, 30°59' E, 100 Alt.), Egypt, where the F_1's seeds were subsequently advanced in 1995/96 season to produce enough F_2 seeds. Field experiments on F_2, F_3, F_4 and F_5 generations of the six crosses were conducted during the winter-spring seasons of 1996/97, 1997/98, 1998/99, and 1999/2000 at the Agricultural Research Station of King Saud University at Dierab, near Riyadh (24° 42' N, 44° 46' E, 400 Alt.), Saudi Arabia. The soil type at the experimental site was silty loam (*Typic Torriorthents*) and the experimental plots, unless treated, were kept under the recommended optimum crop management. Part of the seed bulk of F_2 and each following generation, which was used for planting, was kept in cold storage for final testing. The F_2 of each cross was space planted in four plots, each consisted of 6 rows, 5 m long, and 0.3 m apart. At anthesis, 250

Table (1): Identification, parentage, origin, height, and maturity of 7 spring wheat cultivars used as parents for 6 crosses.

Parent	Parentage	Origin	Height	Maturity
Sakha 69 [‡] (S69)	Inia/RL4220//7C/yr's'-CM15430-25-65-0S	Egypt	Semidwarf	Mid-season
Yecora Rojo (YR)	'Ciano' x 'Sonora 64'-'Klein Rendidor') x/3/ II8156.	USA	Semidwarf	Early to Mid-season
Newana (Ne)	'Sheridan' /2/CI 13253/5* 'Centana'	USA	Semidwarf	Mid-season to Late
Canuck(Can)	'Canthatch' x 'Mida'/'Cadet' // 'Rescue	USA	Semidwarf	Mid-season to Late
Sakha 8 (S8)	Indus/Norteno'S'//PK3418	Egypt	Semidwarf	Mid-season
Giza 160(G160)	Chenap70/Giza155	Egypt	Semidwarf	Early to Mid-season
Giza 155 (G155)	Mida/Cadet//Regent2	Egypt	Tall	Late

[‡] Used as a common female parent to each of the other cultivars.

spikes with similar date of anthesis were tagged in each plot to eliminate the effect of anthesis date on grain size. Ten days after anthesis of the tagged spikes, chemical desiccation was applied to all six rows of two plots of each cross, while the other two plots were kept untreated (without desiccation). The desiccation treatment was applied by spraying the whole plant canopy to full wetting with an aqueous solution of potassium iodide (KI, 0.4% *w/v*) containing a wetting agent (0.2 ml/l detergent). The desiccant was applied at a rate of 125 ml/m^2 using a hand-held boom sprayer allowing spray penetration into the whole plant canopy. For better control over the chemical desiccation effect, one of each adjacent pair of plots was sprayed with the desiccant, while the other was kept non-treated. At maturity, the tagged spikes were collected and separately threshed on a plot basis. The separate seed lots of F_2 and each of the following generations were subjected to mass selection under two parallel programs; selection for large seeds under chemical desiccation and selection for large seeds without desiccation. The mass selection was performed by passing each plot sample over a 2.4-mm diameter screen to remove very small kernels, and then a 3.6 mm diameter screen was used to separate the large seeds from the remaining sample. The selected large-seed bulks of F_2's were seeded as F_2-derived F_3 and F_4 bulks in 1997/98 and 1998/99 seasons, respectively, where further two cycles of mass selection, following the same procedures, were performed on spikes with uniform flowering date. The separation of large seeds of each seed bulk was verified by recording the kernel weight of the selected and remaining seed bulks as mean of two 200-kernel samples. The large seed portions ranged from 6% to 25% of the total weight of a seed bulk depending on selection program, cross, and selection cycle.

The selected 36 large-seed bulks (6 crosses x 3 cycles x 2 treatments; desiccated and non-desiccated) in addition to their respective F_2 base populations and the parent cultivars were tested in the winter-spring season of 1999/2000 under both post-anthesis drought stressful and non-stressful (potential) field environments. A layout of split-plot design in randomized complete block arrangement with four replications was used. The main plots were allocated for irrigation treatments (post-anthesis drought and optimum irrigation), while the tested seed bulks were randomized in sub-plots of 8 rows, 2 m long and 0.25 m apart and seeded with a seeding rate of 300 seed/m^2. Wide borders (3m) were kept among the main plots receiving different irrigation regimes to minimize the underground water permeability. In the stressed treatment, irrigation was halted after early heading stage resulting in severe post-anthesis drought. Non-significant rainfall (4mm) was received during the period from heading to maturity. The post-anthesis drought stress was emphasized by monitored soil water content that showed percent plant available water less than 20% (calculated as percent of the difference between soil water content at field capacity and its content at welting point). In the non-stressed treatment (potential conditions), irrigation was applied to maintain plant available water above 60% of its total amount. At harvest, grain yield was determined from the central four rows of each plot. Test weight (volume weight) was estimated for a constant-volume sample (about 250 ml) and recalculated as kilograms per hectoliter.

Three selection-response cycles for large grain were developed; selection in F_2 and response in F_3 (cycle I), selection in F_3 and response in F_4 (cycle II), and selection in F_4 and response in F_5 (cycle III). The response to selection was compared as difference between the mean of a large-seed bulk of an advanced generation and its respective F_2 base-population mean of each cross. In the final testing season, the post-anthesis drought injury of a pre-specified seed bulk was estimated from the performance of a stressed plot (S) relative to its respective non-stressed plot (C) within the same replicate and calculated as percent injury according to Blum *et al.* (1983):

$$\% \text{ Injury} = [(C - S) / C] \times 100$$

The standard analyses of variance and the linear relationships among the studied traits were performed using Statistical Analysis Software (SAS; SAS Institute Inc. 1992). Mean differences were tested by *LSD* test.

3. RESULTS AND DISCUSSION

Differences in kernel weight were highly significant among crosses, selection environments, and selection-response cycles under both post-anthesis stressed and potential environments (Table 2). Average kernel weight of the selected large-grain bulks at the consecutive selection-response cycles is presented in Table (3). Avoiding the fluctuation in generations mean (Falconer, 1981), response to selection was expressed as difference from F_2 base-population (BP) means of the different crosses (Blum *et al.*, 1991). Furthermore, for better evaluation of response to selection, the selected seed bulks of the different cycles were tested collectively in the final growing season in both drought-stressed and non-stressed plots. Selection for grain size under desiccation effectively increased kernel weight under drought where the accumulated response in cycle III resulted in significantly positive increase in all crosses as compared to their respective F_2 base populations (Table 3). The general trend for selecting under desiccation and testing under drought was for a consistent increase in kernel weight from the first to the second or the third cycle, depending on the cross. In the S69/G160 cross, a significant response to selection was observed in the first selection-response cycle, whereas in most other crosses, a significant response was revealed after the second cycle. The effectiveness of selection under desiccation for sustained kernel weight under stress was also reported by Haley and Quick (1993) and Blum *et al.,* (1991). Differences among wheat genotypes in sustaining large grains under post-anthesis drought and/or chemical desiccation have been ascribed to genetic variation in the plant ability to utilize shoot (mainly stem) reserves of carbohydrates. Some genotypes have high ability to remobilize these reserves to the developing grains while others possess less ability (Hossain *et al.*, 1990; Pheloung and Siddique, 1991).

Selection for large grains under potential conditions (without desiccation) did not result in any significant increase in kernel weight when the selected bulks were tested under drought conditions. A non-significant fluctuation was observed in response to selection from a cycle to another in all crosses (Table 3). Similarly, selection for large grains under chemical desiccation was non-effective in increasing kernel weight when testing was made under potential conditions with even non-significant negative fluctuation in response to selection as observed in the cross S69/G160 (Table 3). These results emphasize that selection for grain filling under potential and stressful conditions operates on different sources for the required assimilate. The selection pressure for grain filling under potential environment may operate on genetic differences mainly in factors affecting the availability of coincided assimilate, such as photosynthetic activities, phloem translocation, and flag leaf longevity (Rawson *et al.*, 1983). However, under post-anthesis drought, the source size of the available assimilate has been reported to be mainly dependable on the capacity of the plant to utilize stem reserves in addition to the above mentioned factors (Pheloung and Siddique, 1991).

Table (2): Analysis of variance for kernel weight, test weight, and grain yield under post-anthesis drought (Stress) and potential (Opt.)field environments.

Source	**df**	**Mean squares**					
		Kernel weight		**Test weight**		**Grain yield**	
		Stress	**Opt.**	**Stress**	**Opt.**	**Stress**	**Opt.**
Crosses	5	135.9**	32.4**	76.6**	48.1**	1.67**	1.41**
Selection Cycles	2	23.0**	7.8	21.5	6.6	0.79**	0.27
Crosses x Cycles	10	0.4	1.2	2.1	5.7	0.07	0.09
Selection Environments	1	67.2**	40.6**	206.4**	75.1**	4.65**	1.09**
Crosses x Sel. Env.	5	0.7	15.5**	2.0	7.9	0.05	0.17
Cycles x Sel. Env.	2	1.3	5.4	8.2	16.6	0.16	0.19
Cross x Cycle x Sel. Env.	10	0.70	2.9	4.6	5.2	0.04	0.09

** Significant at 0.01 probability level.

Table (3): Average kernel weight of three cycles of selection for large grain performed under chemical desiccation (D) and without desiccation (W) in six crosses and tested under post anthesis drought-stressful and potential field environments.

Cross	Testing under post-anthesis drought					Testing under potential environment			
	Cycle	D	$\frac{(D-BP)^{\ddagger}}{BP}$	W	$\frac{(W-BP)^{\ddagger}}{BP}$	D	$\frac{(D-BP)^{\ddagger}}{BP}$	W	$\frac{(W-BP)^{\ddagger}}{BP}$
		mg	%	mg	%	mg	%	mg	%
S69/YR	F2-F3	30.3	6.7	28.4	0.1	39.5	4.0	39.2	3.3
	F3-F4	30.9*	9.0	29.1	2.6	38.5	1.4	40.2	5.8
	F4-F5	31.9**	12.2	30.2	6.2	39.5	4.0	41.7*	9.7
S69/Ne	F2-F3	29.9	6.3	29.4	4.5	38.2	0.6	37.6	-0.8
	F3-F4	30.5*	8.6	29.1	3.6	38.6	1.8	38.7	2.1
	F4-F5	32.7**	16.3	29.8	5.9	39.9	5.3	38.3	1.0
S69/Can	F2-F3	29.8	6.5	28.8	3.0	38.7	2.6	38.1	1.1
	F3-F4	30.5*	9.0	29.4	5.2	38.6	2.3	38.6	2.3
	F4-F5	31.3**	11.8	29.9	7.1	39.0	3.5	39.2	3.9
S69/S8	F2-F3	25.3	5.5	24.1	0.6	40.3	4.7	39.7	3.2
	F3-F4	25.7	7.0	24.9	3.8	38.8	0.8	40.3	4.7
	F4-F5	26.3*	9.5	25.4	5.8	38.7	0.5	42.6**	10.8
S69/G160	F2-F3	27.7*	8.5	25.9	1.5	39.4	-2.7	42.0	3.6
	F3-F4	27.8*	8.9	26.7	4.6	39.6	-2.2	44.2*	9.1
	F4-F5	28.6**	12.3	26.9	5.5	39.4	-2.8	43.9*	8.4
S69/G155	F2-F3	24.8	3.5	24.5	2.3	37.8	0.9	39.2	4.6
	F3-F4	26.0*	8.7	24.6	2.7	38.6	2.9	38.1	1.6
	F4-F5	27.1**	13.3	25.3	5.7	38.1	1.7	38.8	3.6

‡ BP = Mean of F_2 base population.

*, ** = Significant difference from F_2 base-population mean of the respective cross at 0.05, and 0.01 probability levels, respectively.

Selection for large grains under potential conditions was partially effective in increasing kernel weight when plants were subjected to potential environment (both selection and testing were under potential conditions). In this case, the response to selection varied with the cross and the cycle of selection being significant in the second cycle only in one cross (S69/G160), and the third cycle in two other crosses (S69/YR and S69/S8). This relatively slow response to selection for large kernels under potential conditions could be ascribed to a relatively low genetic variation among the tested materials for kernel weight under potential conditions as being evident from the comparison of mean squares due to crosses and selection cycles for kernel weight under stressful and optimal conditions (Table 2).

Wheat breeders used to consider the test weight estimated from primary yield trials as an early indicator for milling quality. Results of our study indicated that selection for large grains generally caused response in test weight that was generally corresponded with that of kernel weight. A relatively strong and significant association (R^2 = 0.78) between kernel weight and test weight was prominent for seed bulks selected under chemical desiccation and tested under post-anthesis drought (Fig. 1). This strong linear relationship indicates that selection for large kernels under desiccation was effective in improving test weight in bulks evaluated under post-anthesis drought. Oppositely, selection for large kernels under potential conditions (without desiccation) was relatively less effective in improving test weight under post-anthesis drought (Fig. 1). Under these conditions, the association between kernel weight and test weight was relatively lower (R^2 = 0.62) comparing to bulks selected under desiccation.

Selection for kernel weight under desiccation simultaneously improved grain yield under post-anthesis drought. Fig. (2) illustrates the overall improvement in kernel weight and grain yield under post-anthesis drought when large grains were selected under chemical desiccation comparing to selection without desiccation. A large portion (84%) of the variation in grain yield under post-anthesis drought among the seed bulks selected under desiccation could be ascribed to variation in kernel weight. This, however, was not the case for bulks selected under potential conditions, where yield under

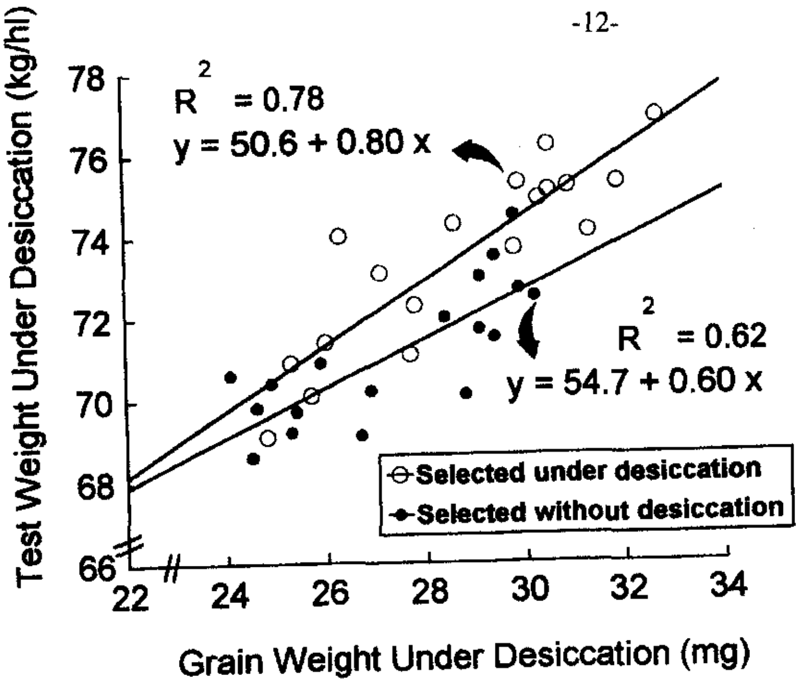

Fig. (1): The regression relationship between grain weight and test weight under drought-stressful field environment for seed bulks selected for large grains under chemical desiccation and without desiccation.

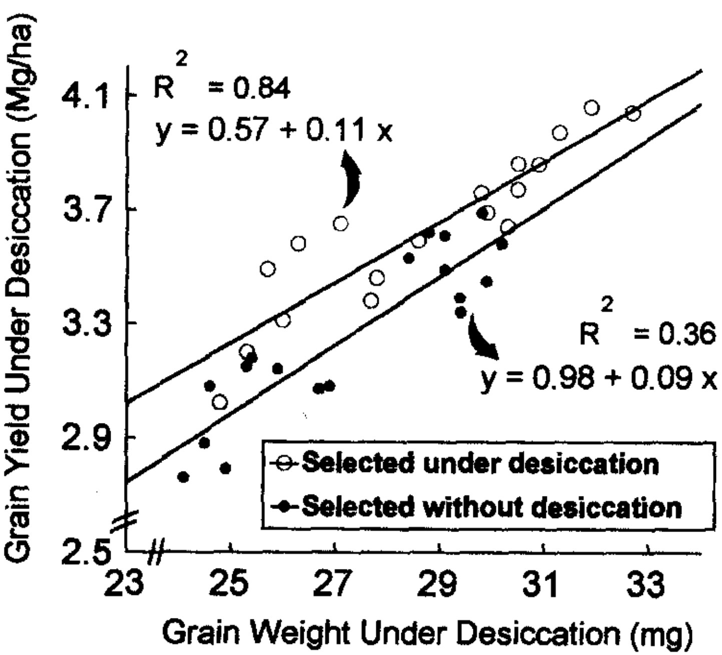

Fig.(2): The regression relationship between grain weight and grain yield under drought-stressful field environment for seed bulks selected for large grains under chemical desiccation and without desiccation.

post-anthesis drought was non-significantly related to kernel weight ($R^2 = 0.36$, Fig. 2).

Significant differences in post-anthesis drought injury were revealed for kernel weight, test weight, and grain yield among crosses, selection cycles, and selection environments (Table 4). The cross S69/S8 generally suffered the greatest drought injury for kernel weight, test weight, and rain yield followed by S69/G160 for kernel weight and grain yield, and S69/Can for test weight. The high sensitivity of crosses involving Egyptian cultivars could be explained by the environment of optimum irrigation where these cultivars were developed. In comparison, the cross S69/YR which includes the widely grown cultivar in Saudi Arabia, YR, was intermediate in its drought injury. In general, the response of the crosses to post-anthesis drought appeared to be closely related to the response exhibited by their parents the final season evaluation. The results of variance analysis in Table (2) further supported this trend where interactions involving crosses and other main effects were generally non-significant under post-anthesis drought. This trend suggests that parental response might be used to predict cross performance under post-anthesis drought. The results of this study generally demonstrate that early-generation bulks, selected under chemical desiccation, may be used to identify superior crosses for developing wheat lines suffering less post-anthesis drought injury. Other studies on self-pollinated crops reported effectiveness of selection among early-generation bulks that may be used to identify superior crosses prior to line development (Cregan and Busch, 1977; Singh *et al.*, 1990).

In conclusion, taking kernel weight response to selection as an indicator of improved grain filling, it appears that ample genetic variation existed among the studied seed bulks in the ability to utilize stem reserves for grain filling in the absence of transient photosynthesis. For better identification of genotypes possessing this ability, transient photosynthesis should be eliminated where chemical desiccation was proved to be effective. Early-generation mass selection combined with chemical desiccation were effective in identifying seed bulks superior in their kernel weight under post-anthesis drought. However, selection should be applied under actual desiccation where selection under potential conditions was relatively ineffective. Such selection pressure for sustainable kernel weight simultaneously improved test weight and grain yield under post-anthesis drought.

Table (4): Mean percent injury for kernel weight, test weight, and grain yield of selected seed bulks of six wheat crosses tested under contrasting post-anthesis water regimes.

Cross/ Treatment	Kernel weight	Test weight	Grain yield
	%	%	%
Crosses			
S69/YR	24.0 c	4.3 c	21.5 c
S69/Ne	21.4 d	3.1 e	17.8 d
S69/Can	22.3 cd	4.8 b	21.1 c
S69/S8	36.6 a	6.7 a	24.6 a
S69/G160	33.6 b	3.7 d	23.8 ab
S69/G155	33.8 b	5.1 b	22.9 b
Selection Cycle			
Cycle I	29.7 a	5.7 a	23.3 a
Cycle II	28.7 ab	4.3 b	22.5 a
Cycle III	27.5 b	3.8 c	20.1 b
Selection Environment			
Desiccation	26.0 b	4.0 b	19.4 b
Without Desiccation	31.3 a	5.3 a	24.5 a

Within main effects, means within a column followed by the same letter are not significantly ,different at 0.05 probability level.

4. REFERENCES

Alexander W.L., Smith E.L. and Dhanasobhan C. (1984). A comparison of yield and yield component selection in winter wheat. Euphytica 33:953-961.

Arraudeau M.A. (1989). Breeding strategies for drought resistance. p.107-116. In F.W.G. Baker (ed.). Drought resistance in cereals. CAB International, UK.

Blum A., Gozlan G., Mayer J. and Sinmena B. (1997). The effect of dwarfing genes on sorghum grain filling from remobilized stem reserves, under stress. Field Crops Res. 52:43-54.

Blum A., Shpiler L., Gozlan G., Mayer J. and Sinmena B. (1991). Mass selection of wheat for grain filling without transient photosynthesis. Euphytica, 54:111-116.

Blum A., Poiarkova H., Gozlan G. and Mayer J. (1983). Chemical desiccation of wheat plants as a simulator of post-anthesis stress. I. Effects on translocation and kernel growth. Field Crops Res. 6:51-58.

Boote K.J., Bennett J.M., Sinclair T.R. and Paulsen G.M. (1994). Physiology and determination of crop yield. CSSA, and SSSA, Madison, WI.

Ceccarelli S. and Grando S. (1996). Drought as a challenge for the plant breeder. Plant Growth Regulation. 20:149-155.

Cregan P.A. and Busch R.H. (1977). Early generation bulk hybrid yield testing of adapted hard red spring wheat crosses. Crop Sci. 17:887-891.

Davidson D.J. and Chevalier P.M. (1992). Storage and remobilization of water-soluble carbohydrates in stem of spring wheat. Crop Sci. 32:186-190.

Derera N.F. and Bhatt G.M. (1974). Effectiveness of mechanical mass selection in wheat. (*Triticum aestivum* L.). Aust. J. Agric. Res. 23:761-768.

Falconer D.S. (1981). Introduction to quantitative genetics. Longman Inc., New York

Haley S.D. and Quick J.S. (1993). Early-generation selection for chemical desiccation tolerance in winter wheat. Crop Sci. 33:1217-1223.

Hossain A. B. S., Sears R.G., Cox T.S. and Paulsen G.M. (1990). Desiccation tolerance and its relationship to assimilate partitioning in winter wheat. Crop Sci. 30:622-627.

Knott D.R. (1972). Effects of selection for F_2 plant yield on subsequent generations in wheat. Can. J. Plant Sci. 52:721-726.

Lanini B.J. and Marshall H.G. (1990). Selection for high specific gravity seed in oat populations heterogenous for naked genotypes. Crop Sci. 30:565-567.

Ludlow M.M. and Muchow R.C. (1990). A critical evaluation of traits for improving crop yields in water-limited environments. Adv. Agron. 43:107-153.

McVetty P.B.E. and Evans L.E. (1980). Breeding methodology in wheat. I. Determination of characters measured on F_2 spaced plants for yield selection in spring wheat. Crop Sci. 20:583-586.

Nicolas M.E. and Turner N.C. (1993). Use of chemical desiccants and senescing agents to select wheat lines maintaining stable grain size during post-anthesis drought. Field Crops Res. 31:155-171.

Pheloung P.C. and Siddique K.H.M. (1991). Contribution of stem dry matter to grain yield in wheat cultivars. Aust. J. Plant Physiol. 18:53-64.

Rasmusson D.C. (1987). An evaluation of ideotype breeding. Crop Sci. 27:1140-1146.

Rawson H.M., Hindmarsh J.H, Fischer R.A., and Stockman Y.M. (1983). Changes in leaf photosynthesis with plant ontogeny and relationship with yield per ear in wheat cultivars and 120 progeny. Aust. J. Plant Physiol. 10:503-514.

Saadalla M.M. (1994a). Quantification of drought tolerance in spring wheat. Alex. J. Agric. Res. 39:177-195.

Saadalla M.M. (1994b). Response to early-generation selection for yield and yield components in wheat. Cereal Research Communication 22(3):187-193.

SAS Institute Inc. (1992). SAS/STAT user's guide. 6.08 ed. SAS Inst. Cary, NC, U.S.A.

Schnyder H. (1993). The role of carbohydrate storage and redistribution in the source-sink relations of wheat and barley during grain filling. New Physiol. 123:233-245.

Singh S.P., Lepiz R., Gutierrez J.A., Urrea C., Molina A. and Teran H. (1990). Yield testing of early generation populations of common bean. Crop Sci. 30:874-878.

Sneep J. (1977). Selection for yield in early generations of self-fertilizing crops. Euphytica 26:27-30.

الانتخاب فى الأجيال المبكرة باستعمال التجفيف الكيماوي لتحسين امتلاء الحبة فى القمح

محمد محمد سعد الله

قسم المحاصيل – كلية الزراعة – جامعة الإسكندرية – فرع دمنهور

ملخص

حدوث الجفاف فى مرحلة ما بعد الإزهار له تأثير كبير على محصول حبوب القمح فى المناطق الجافة وشبه الجافة أساسا من خلال تأثيراته السلبية على نمو الحبة . وقد أقترح التجفيف الكيماوي لمحاكاة جفاف ما بعد الإزهار لتمكين مربى النبات من انتخاب تراكيب وراثية مقاومة فى الحقل . وأجريت هذه الدراسة لاختبار فعالية الانتخاب المبكر لكبر حجم الحبة تحت ظروف التجفيف الكيماوي فى ستة هجن من القمح الربيعي (*Triticum aestivum* L.) . وأجريت معاملة التجفيف الكيماوي ١٠ أيام بعد الإزهار برش النباتات حتى الابتلال التام بأيوديد البوتاسيوم (٠,٤% وزن/حجم) ، وطبقت ٣ دورات من الانتخاب الإجمالي للحبوب الكبيرة على الأجيال الثاني والثالث والرابع لأحواض تجريبية عوملت بالمجفف وكذلك لأحواض تجريبية غير معاملة ، وتم اختبار منتخبات البذور من الدورات المختلفة فى الموسم الأخير تحت ظروف حقلية شملت كل من جفاف (منع الري) ما بعد الإزهار وظروف غير مجهدة . وأتضح من تتبع الاستجابة للانتخاب أن التجفيف الكيماوي المصاحب للانتخاب الإجمالي قد تسببا وبشكل مؤثر فى تحسين وزن الحبوب تحت إجهاد جفاف ما بعد الإزهار حيث لوحظ اتجاه عام لزيادة مستمرة فى وزن الحبة بتقدم الدورات الانتخابية. وعلى العكس من ذلك لم يؤثر الضغط الانتخابي لامتلاء الحبوب تحت الظروف غير المجهدة (بدون تجفيف كيماوي) فى تحسين وزن الحبوب عندما اختبرت تحت ظروف جفاف ما بعد الإزهار ، بينما كان الانتخاب لكبر حجم الحبوب بدون تطبيق التجفيف الكيماوي فعالا نسبيا إلى حد ما فى زيادة وزن الحبوب تحت الظروف غير المجهدة. وبالإضافة لما سبق تسبب الانتخاب الإجمالي للحبوب كبيرة الحجم فى استجابة متوازية فى كل من الوزن النوعي ومحصول الحبوب حيث كان التحسن متزامنا فى كل من وزن الحبة والوزن النوعي للحبوب

ومحصول الحبوب تحت ظروف جفاف ما بعد الإزهار وذلك عند الانتخاب لكبر الحبوب تحت ظروف التجفيف الكيماوي ، بالإضافة إلى أن منتخبات البذور فى ظروف غير مجففة كان وزنها النوعي ومحصول حبوبها أقل نسبيا عندما اختبرت تحت ظروف جفاف ما بعد الإزهار مقارنة بالبذور التى انتخبت واختبرت تحت ظروف الإجهاد. وتأكدت فعالية الانتخاب لكبر الحبوب تحت ظروف إجهاد التجفيف بالانخفاض المعنوي فى تلف امتلاء الحبوب لبذور الأجيال المبكرة المنتخبة تحت التجفيف عند اختبارها تحت جفاف ما بعد الإزهار. ولوحظت اختلافات مماثلة فى تلف كل من الوزن النوعي ومحصول الحبوب بين منتخبات البذور التى تم اختبارها. وأكدت هذه الدراسة وفرة التصنيفات الوراثية بين وداخل الهجن التى شملتها الدراسة فى قدرتها على الاستفادة على المواد المخزنة بالسوق فى امتلاء الحبوب وكذلك فعالية انتخاب الأجيال المبكرة مصحوبا بالتجفيف الكيماوي فى التعرف على تراكيب وراثية متفوقة فى وزن الحبة والوزن النوعي ومحصول الحبوب.

المجلة العلمية لكلية الزراعة – جامعة القاهرة – المجلد (٥٣) العدد الأول (يناير ٢٠٠٢): ١-٢٠.