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EFFECT OF SEED CLASSES, HARVESTING DATES AND STORAGE PERIODS ON YIELD AND SEED QUALITY OF WHEAT

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ABSTRACT

Two experiments were conducted at the Experimental Farm of Agronomy Department, Faculty of Agriculture, Mansoura University, Egypt during 2007/2008 and 2008/2009 seasons. The aim of the first experiment, was to study the effect of harvesting dates 45, 55, 65 and 75 days from 50% heading under three wheat seed classes (foundation, registered and certified) on yield and its components (c.v. Giza168). The second experiment was conducted at the laboratory of Seed Technology Research Unit, El-Mansoura, Dakahlia Governorate and aimed to study the effect of harvesting dates and wheat seed classes seed quality during different storage periods, i.e. (0, 3 and 6 months after harvesting).

The results revealed that, harvesting dates had significant effects on grains moisture content, number of spikes/m^2, spike weight, number of spikeletes/ spike, number of grains/spike, grains spike weight, 1000-grain weight and grain yield. Harvesting wheat plants after 65 day from 50% heading produced the highest means yield and its components traits i.e. (spikes number/m^2, 1000-seed weight, grain yield) in both seasons. Result showed that insignificant differences among seed classes on growth characters, yield and its components. In general, number of spike/m^2, spike length, number of spikeletes/spike, number of grain/spike and grain yield were recorded maximum value from foundation seed followed by registered and certified seed category.

Increasing storage periods had significant effect on all the studied traits. While the prolong the storage periods from 0 to 6 months from storage lead to the decrease in germination percentage, speed of germination, germination energy and germination rate and the decrease in seedling vigor traits (seedling length and fresh and dry weight) and carbohydrate percentage in the both seasons. While this increase in storage period lead to the increase in mean germination time, protein content, insect infection percentage and seed dry weight loss percentage in the first and second seasons. Harvesting dates significantly affected on germination energy, germination rate, seedling fresh weight, seedling dry weight, insect infection percentage, seed dry weight loss, protein content and carbohydrate percentage in the first and second seasons. While it had different effects on speed of germination only in the first season.

The interaction among storage periods, harvesting date and seed classes had a significant effect on germination energy and seedling fresh weight in the first and second seasons and seedling dry weight in the first season only.

INTRODUCTION

Wheat *(Triticum aestivum valgare L.*), is considered the world's leading cereal crop. In Egypt, wheat is considered the main source of human food crops. The over expanding of increasing population in Egypt have under lined the importance of increasing the productivity of wheat per unit area of land since the area devoted for wheat production is limited.

Seed production follows a generation system to ensure that all seed that is marketed to farmers originates from a known source (breeder seed). When a variety is officially released, the small amount of breeder seed received from the breeder (Agricultural Research Centre) is multiplied through a number of generations before it becomes available to the farmers in larger quantities as certified seed. For wheat, four generations are commonly used in Egypt (Breeder, Foundation, Registered and Certified) FAO (1975) and Van Gastel and Hopkins (1988). Selim (2004) revealed that the genetic purity based on number of types and seed fingerprint were significantly reduced from planting second generation of farmer saved seed compared with those from standard and certified seed. Amir Zaman et al (2007) reported that maximum emergence, maximum spikes/m^2, grains spike, grain yield and thousand grain weight were recorded from pre-basic seed followed by basic and certified seed category.

Harvesting dates is an important factor to increasing the total crop yield. Most kinds of seed reached maturity at moisture content to higher for mechanical harvest. The post maturation per-harvest period normally rang from 1 to 4 weeks. Adverse climatic conditions, especially high humidity, worm….etc result in rapid and severe of the seed and so on the degree of seed deterioration that occurs in seed period to harvest determines their quality at harvest and during storage Murage (1993). If the harvest started late the seed becomes to dry and the rate of shattering well be higher and the plants exposed lodging, birds, rodents and climatic while, Johnson *et al.* (1980) in USA reported that average yield losses were about 10% when wheat delayed at harvest by 21 days in the mid Atlanta. Farrer *et al.* (2006), concluded that yield losses of nearly 20% were possible with only 8 days between harvests. The total precipitation and the prevalent temperature are important factors affecting quality. They also added that seed shattering increase as grain dries and hot dry weather facilitates these dry processes. Baque *et al.* (2007) in Bangladesh, reported that the maximum 1000-seed weight and seed yield was recorded under the interaction of 110, 120 and 120 kg seeds/ha which was harvested at 40, 50 and 60 days after anthesis, respectively. Where as, the highest moisture content (32.53%) and maximum vigour index of seeds were found following 130 and 110 kg seeds ha^{-1} along with time of harvest at 30 and 50 DAA, respectively. Qun *et al.* (2007) reported that, seed vigor is a more promising seed quality character reflecting potential seed germination, field emergence, physiological maturity of the seed at harvest defined, as the time enough for seeds to reach its maximum dry weight and its one of the factors that influence the vigour of any seed lot. Sinclair and Jamieson (2008) reported that harvest dates showed significant effects on wheat grain yield, spikes number /m^2, number of spikeletes/ spike and number of grains/spike. They also added that harvest date should be practiced early within two weeks after full maturity to give high grain yield, while delay after that had adverse effects on the grain yield. El-Emam *et al.* (2009) revealed that harvesting wheat after 50 days from 50% heading increased gradually both of grain yield/ feddan and 1000-grain weight and quality characters of seed, such as germination percentage and germination rate, plumule and radical length, seedling dry weight and carbohydrate

content in both seasons. However delaying harvest to 80 days from 50% heading decreased moisture content. Harvesting plants at 50, 60 and 80 days after 50% heading reduced grain yield 60.84, 16.24 and 3.91% in the first season and 64.17, 18.96 and 5.08% in the second season comparing with harvest at 70 days after 50% heading in both respective seasons.

After harvest the germination capacity or viability of seed remains constant over periods of time ranging from weeks and months to years depending on the kind of seed stored and storage conditions. Eventually, however, the viability begins to fall and it can fall slowly or quickly. Good storage cannot improve the quality of poor seed, therefore only seed with high germination and high vigour should be put into storage. Mersal *et al.* (2006) revealed that prolonging storage period and high seed moisture content reduced germinability and seedling vigour. Meanwhile, increasing storage period and high seed moisture content increased mean germination time, insect infestation and dry weight losses of the seed. Malaker *et al.* (2008) found that moisture content infection increased and seed germination decreased with the increase of storage period. Various fungal floras associated with wheat seeds differed in their prevalence depending on the length of storage period. The population of field fungi decreased while that of storage fungi increased with the progress of storage period.

The present research aimed to study the performance of wheat under different harvesting dates and seed class on wheat growth, yield and its components and the effect of harvesting dates, seed class and storage period on wheat seed germination, seed vigour, seedling vigour traits, insect infestation and seed dry weight loss.

MATERIALS AND METHODS

The first experiment was conducted at the Experimental Farm of Agronomy Department, Faculty of Agriculture, Mansoura University, Egypt during 2007/2008 and 2008/2009 seasons. The aim was to study the effect of harvesting dates 45, 55, 65 and 75 days from 50% heading and three wheat seed classes (foundation, registered and certified) on yield and its components. Seed of wheat (c.v. Giza168) classes were obtained from Wheat Research Department, Field Crops Research Institute, ARC. A Split plot design with four replicates was used harvesting dates were assigned in main plots and the seed classes were allocated to the sub plots. The area of each sub plot was 10.5 m^2 (3m × 3.5m).

The preceding crop was maize in both seasons. Land preparation, crop management, all agronomic practices and treatments, except both studied factors, were as recommended for the region for the crop cultivation. The soil of the experimental site was clay in texture, containing organic matter of 2.9 and 1.7 %, total N of 0.078 and 0.087 , available P of 6.0 and 9.32 ppm and available K of 310 and 340 ppm in the first and second season, respectively.

The second experiment was conducted Factorial experiment wile C.B.D. at the laboratory of Seed Technology Research Unit, ARC, El-Mansoura, Dakahlia Governorate. The aimed of this study was effect of harvesting dates, wheat seed classes and different storage periods, i.e. (0, 3 and 6 months after harvesting) on seed quality traits.

Studied traits:

At harvest plants of center area of 1 m^2 of each sub plot were harvest and the data are recorded:

1- **Seed moisture content (%):** ten spikes of the main stems were taken from each plot and handy thrashed and after that seed moisture content was determined according to ISTA, (1985a). The moisture content (M) is calculated to one decimal place using the formula:

$$\text{Moisture content} = \frac{\text{Loss of weight}}{\text{initial weight of seed}} \times 100$$

2- Number of spikes/m^2. 3- Number of spikelets/spike. 4- spike weight. 5- Number of grains/ spike. 6- Grains spike weight (g). 7- 1000-grain weight (g). 8- Grain yield (ardab/fed.)

9. **Germination percentages:** It measured according to the method outlined in the rules seed testing (ISTA, 1999) and defined as the total number of normal seedling after 8 days.
10. **Speed of germination:** number of normal seedling at the first count (fourth day from sowing).
11. **Germination energy:** Germination energy was calculated according to this formula, Alvarado and Bradoford (1987).

$$\text{Germination energy} = \frac{N1+N2+N3+N4}{N} \times 100$$ Where, N1, N2, N3 and N4 = first, second, third and fourth counts, respectively. N = Number of germinated seed.

12- **Mean germination time:** according to this formula, Alvarado and Bradoford (1987).

$$\text{Mean germination time} = \frac{(N1\times T1)+(N2\times T2)+(N3\times T3)+(N4\times T4)}{(N1+N2+N3+N4)}$$

Where, N1, N2, N3 and N4 = First, second, third and fourth counts, respectively. T1, T2, T3 and T4 = Time of first, second, third and fourth counts, respectively.

13-**Germination rate:** It was defined according to the procedure reported by Barteltt, (1937).

$$\text{Germination rate} = \frac{a+(a+b)+(a+b+c)+\ldots\ldots\ldots+(a+b+c+m)}{n\,(a+b+c+\ldots\ldots\ldots+m)}$$

Where, (a) Number of seedlings emerged at the first count. (b) Number of seedlings emerged at the second count. (c) Number of seedlings emerged at the third count. (m) Number of seedlings emerged at the final count. (n) Number of counts.

14. **Plumule and radicale length:** During the final count, ten normal seedlings from each replicate were taken randomly to measure the plumule and radicale length in cm.
15. **Seedling fresh and dry weights:** According to Krishnasamy and Seshu (1990).
16. **Insect infestation percentage:** According this formula, (Jood *et al.* 1996).

$$\text{percent damage kernels} = \frac{\text{Number of insect damage}}{\text{Number of total grains inspected}} \times 100$$

17. **Seed dry weight loss percentage:** As follows according to (Dick 1987).

$$\text{Dry mass (weight) loss \%} = \frac{\text{(U Nd) - (D Nu)}}{\text{U (Nd + Nu)}} \times 100$$

Where, Nu = number of undamaged kernels, Nd = number of damage kernels, U = weight of undamaged kernels and D = weight of damage kernels.

18- **Protein content:** Estimated according to the improved Kjldahl method of AOAC (1999).

19- **Carbohydrate percentage:** Measured according to Dubois and Gilles, (1956).

Collected data were subjected to the statistical analysis as a usual technique of analysis of variance (ANOVA) for the Factorial Completely Randomized Block Design (FCRBD) as mentioned by Gomez and Gomez (1984).

The treatment averages were compared by using the least significant difference (LSD) method at 5% level of probability. (Gomez and Gomez 1984).

RESULTS AND DISCUSSION

The field experiments

1- Harvesting dates effect:

Results in Tables 1and 2 showed that harvesting dates had significant effects on grain moisture content, number of spikes/m^2, spike weight, number of spikeletes/ spike, number of grains/spike, grains spike weight, 1000-grain weight and grain yield in both seasons. With respect to the effect of harvesting dates on seed moisture content during harvest, the results revealed that harvesting wheat seed after 45 days from 50% heading had the highest moisture content as compared with wheat seed which harvested after 55, 65 and 75 days from 50% heading, while the moisture content ranged from (33.7 and 30.3), (20.2 and 20.9), (11.6 and 11.9) and 11.1 and 10.1) in the first and second seasons, respectively. Similar results were reported by Calderini *et al.*, (2000), Baque *et al.* (2007) and El-Emam *et al.* (2009). Also, harvesting dates significantly affected on wheat seed yield and its components (number of spikes/m^2, spike weight, number of spikeletes/ spike, grains spike weight, 1000-grain weight and grain yield). Harvesting wheat plants earliest (after 45 days from 50% heading) lead to the reductions in yield and its components. Characters compared with the other harvesting times except grains number /spike only in the first season and followed with the second harvesting date (55 days from 50% heading) but produce the highest means of grains number/spike only in the second season. Harvesting wheat plants after 65 days from 50% heading produced the highest means yield and its components traits i.e. (spikes number/m^2, 1000-seed weight and grain yield) in both seasons. Meanwhile the reduction in yield and its components began with the lately harvesting date (75 days from

50% heading) except number of spikes/m^2, weight of spike and number spikeletes/spike. The increase in yield at harvest date 65 days after 50% heading may be attributed to this harvest date correspond to full maturity stage while dry matter translocated and storage completed in wheat seed which led to enhanced 1000-grain weight resulted in raising seed yield.

Table 1: Averages of grain moisture content (%), number of spikes/m^2, spike length (cm) and spike weight(g) of wheat as affected by harvesting dates and seed classes as well as their interaction during 2007/2008 and 2008/2009 seasons.

Characters / Treatments	Grain moisture content (%)		Number of spikes/m^2		Spike length (cm)		spike weight (g)	
	2007/08	2008/09	2007/08	2008/09	2007/08	2008/09	2007/08	2008/09
A- Harvesting dates (days after 50% heading)								
45	33.7	30.3	384	382	11.1	10.4	3.4	3.4
55	20.2	20.9	488	476	11.3	10.5	4.6	4.1
65	11.6	11.9	613	588	11.5	10.7	4.7	4.2
75	11.1	10.1	609	606	11.2	10.4	4.8	4.2
F. test	**	**	**	**	NS	NS	**	**
LSD at 5%	2.6	4.9	119	103	-	-	0.43	0.15
B- Seed classes								
Foundation	19.5	17.9	530	531	11.3	10.6	4.3	4.0
Registered	18.9	18.6	523	469	11.3	10.5	4.5	4.1
Certified	19.1	18.5	518	512	11.2	10.5	4.4	4.0
F. test	NS	NS	NS	NS	NS	NS	NS	NS
LSD at 5%	-	-	-	-	-	-	-	-
C-Interaction	NS	NS	NS	NS	NS	NS	NS	NS

Table 2: Averages of number of spikeletes/spike, number of grains/spike, grains spike weight (g), 1000-grain weight (g) and grain yield (ardab/fed) of wheat as affected by harvesting dates and seed classes as well as their interactions during 2007/2008 and 2008/2009 seasons.

Characters / Treatments	Number of spikeletes/spike		Number of grains/spike		Grains spike weight (g)		1000-grain weight(gm)		Grain yield (ardab/fed)	
	2007/08	2008/09	2007/08	2008/09	2007/08	2008/09	2007/08	2008/09	2007/08	2008/09
A- Harvesting dates (days after 50% heading)										
45	18.5	18.5	60.9	56.9	2.2	2.0	43.1	43.2	13.6	13.7
55	19.6	19.7	57.9	57.9	2.9	2.6	44.6	44.7	20.8	17.6
65	20.2	20.3	54.1	54.9	2.7	2.4	47.0	47.1	25.7	19.6
75	20.5	20.5	52.4	51.7	2.5	2.2	45.8	46.0	25.5	17.8
F. test	**	**	**	**	**	**	**	**	**	**
LSD at 5%	0.6	0.5	5.5	3.0	0.4	0.2	2.1	2.4	5.7	3.0
B- Seed classes										
Foundation	20.3	20.4	56.6	55.5	2.5	2.3	45.1	45.1	22.2	17.8
Registered	18.9	18.9	56.3	55.7	2.6	2.3	45.3	45.5	20.4	16.0
Certified	19.9	20.0	56.1	54.8	2.6	2.3	45.0	45.1	21.6	17.8
F. test	*	*	NS	NS	NS	NS	NS	NS	NS	NS
LSD at 5%	2.2	1.2	-	-	-	-	-	-	-	-
C-Interaction	NS	NS	NS	NS	NS	NS	NS	**	NS	NS

These results are in agreement with those obtained by El Ganbeehy *et al.* (1993), Baque *et al.* (2007), Sinclair and Jamieson (2008) and El-Emam *et al.* (2009)

2- Seed class effect:

Results presented in Tables 1 and 2 showed that insignificant differences among seed class on growth characters, yield and its components. In general, maximum number of spikes/m^2, spike length, number of spikeletes/spike, number of grains/spike and grain yield were recorded from foundation seed followed by registered and certified seed category. Similar results were obtained by El Sayed (2005) and Amir Zaman *et al.* (2007).

3-Interaction effect:

Results presented in Tables 1 and 2 showed that insignificant effect on growth characters, yield and its components in the two seasons.

The laboratory experiments

1- Harvesting dates effect:

Results presented in Tables 3, 4 and 5 showed that harvesting dates significantly affected on germination energy, germination rate, seedling fresh weight, seedling dry weight, insect infection percentage, seed dry weight loss, protein content and carbohydrate percentage in the first and second seasons. While it had different effects on speed of germination only in the first season. On contrast, no significant effects were observed on other traits. The highest mean of germination speed, germination energy, germination rate, seedling fresh and dry weight and carbohydrate percentage were obtained with 3rd harvesting date (65 day after 50% heading) in the first and second seasons. On contrast the lowest mean of germination speed, germination energy, germination rate, seedling fresh and dry weight and carbohydrate percentage were obtained with first harvesting date (45 day after 50% heading) in the first and second seasons. At the first harvesting date (45 day after 50% heading) insect infestation percentage was increased, while it decreased with increasing harvesting dates to 55, 65 and 75 day after 50% heading in the first and second seasons. The lowest means of seed dry weight loss was obtained at the fourth harvesting date (75 day after 50% heading). While the highest mean of seed dry weight loss was recorded at the first harvesting date (45 day after 50% heading) in the first and second seasons. At the first harvesting date (45 day after 50% heading) protein content were (11.0 and 11.2), while it increased with increasing harvesting dates to 55, 65 and 75 day after 50% heading in the first and second seasons. Similar results were obtained by (FAO, 1983), Mersal, (2005), Qun *et al.* (2007) and El-Emam *et al.* (2009).

2- Effect of seed classes:

Results presented in Tables 3, 4 and 5 showed that seed class had different effects on seedling dry weight in the second season. Foundation and certified seed recorded the highest mean of seedling dry weight (0.35 g). On contrast the lowest mean of seedlings dry weight (0.33 g) was obtained from registered seed. On contrast, no significant effects were observed on al the studied trails in both seasons.

Table 3: Averages of germination percentage, speed of germination, germination energy, mean germination time and germination rate of wheat seed as affected by storage periods, harvesting dates and seed classes as well as their interactions during 2007/2008 and 2008/2009 seasons.

Characters / Treatments	Germination percentage		Speed of germination		Germination energy		Mean germination time (day)		Germination rate	
	2007/08	2008/09	2007/08	2008/09	2007/08	2008/09	2007/08	2008/09	2007/08	2008/09
A. Harvesting dates (days after 50% heading)										
45	89.1	91.2	89.8	94.0	51.7	53.5	3.1	3.5	0.683	0.703
55	90.5	92.2	91.3	93.2	69.4	71.3	3.2	3.5	0.778	0.789
65	90.2	93.1	91.9	94.1	70.6	72.3	3.3	3.5	0.828	0.834
75	90.7	93.6	91.4	95.8	63.8	66.6	3.2	3.5	0.751	0.761
F. test	NS	NS	**	NS	**	**	NS	NS	**	**
LSD at 5%	-	-	1.6	-	9.5	8.9	-	-	0.05	0.04
B. Seed classes										
Foundation	89.7	92.8	90.4	93.9	61.6	64.2	3.2	3.6	0.753	0.770
Registered	89.7	92.3	91.2	94.5	67.5	69.3	3.1	3.4	0.780	0.790
Certified	90.9	92.4	91.7	94.4	62.5	64.3	3.3	3.6	0.746	0.755
F. test	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
LSD at 5%	-	-	-	-	-	-	-	-	-	-
C. Storage periods/ months										
0	97.7	98.4	98.4	99.0	81.7	84.2	2.7	3.0	0.863	0.876
3	90.8	92.2	91.6	93.9	60.3	62.0	3.4	3.7	0.722	0.737
6	81.8	86.9	83.3	90.0	49.7	51.4	3.5	3.8	0.695	0.702
F. test	**	**	**	**	**	**	**	*	**	**
LSD at 5%	1.6	2.8	1.1	1.9	13.9	10.9	0.2	0.4	0.04	0.04
D. F.test Interaction										
AX B	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
AX C	NS	NS	NS	NS	NS	NS	**	**	NS	NS
BXC	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
AX BXC	NS	NS	NS	NS	**	**	NS	NS	NS	NS

3- Storage periods effect:

Results presented in Tables 3, 4 and 5 showed that increasing storage periods had significant effect on all the studied traits. While the prolong storage periods from 0 to 6 months lead to the decrease in germination percentage, speed of germination, germination energy, germination rate and the decrease in seedling vigor traits (seedling length, fresh and dry weights), carbohydrate percentage in both seasons. Also this increase in storage periods lead to the increase in mean germination time (day) and protein content in the first and second seasons. Also increasing storage period from 3 to 6 months lead to the increase in insect infection percentage and seed dry weight loss percentage in the first and second seasons. Similar results were obtained by El-Borai *et al.* (1993), Jood *et al.* (1996), Helal *et al.* (1997), Mersal (2000), Mersal, *et al.* (2006) and Malaker *et al.* (2008).

Table 4: Averages of plumule length, radicale length, seedling fresh weight (g), seedling dry weight (g) and insect infection percentage of wheat seed as affected by storage periods, harvesting dates and seed classes as well as their interactions during 2007/2008 and 2008/2009 seasons.

Characters / Treatments	plumule length (cm)		Radicale length (cm)		Seedling fresh weight (g)		Seedling dry weight (g)		Insect infection percentage	
	2007/08	2008/09	2007/08	2008/09	2007/08	2008/09	2007/08	2008/09	2007/08	2008/09
A. Harvesting dates (days after 50% heading)										
45 D.A. 50% H.	6.1	6.3	6.6	6.8	1.59	1.55	0.38	0.30	5.3	4.4
55 D.A. 50% H.	6.5	6.7	6.8	7.0	1.66	1.87	0.43	0.35	4.6	4.1
65 D.A. 50% H.	6.4	6.5	6.7	6.9	1.80	1.94	0.44	0.38	3.7	3.6
75 D.A. 50% H.	6.2	6.4	6.7	6.8	1.76	1.79	0.42	0.34	3.3	3.1
F. test	NS	NS	NS	NS	**	**	**	**	**	**
LSD at 5%	-	-	-	-	0.11	0.09	0.03	0.02	0.6	0.3
B. Seed classes										
Foundation	6.2	6.5	6.7	6.9	1.73	1.81	0.43	0.35	4.1	3.8
Registered	6.4	6.6	6.8	6.9	1.69	1.76	0.41	0.33	4.3	3.8
Certified	6.3	6.5	6.7	6.8	1.69	1.79	0.42	0.35	4.2	3.8
F. test	NS	NS	NS	NS	NS	NS	NS	**	NS	NS
LSD at 5%	-	-	-	-	-	-	-	0.01	-	-
C. Storage periods/ months										
0	6.8	6.8	6.9	7.1	2.56	2.16	0.46	0.38	0.0	0.0
3	6.2	6.5	6.7	6.9	1.34	1.80	0.44	0.35	4.3	3.8
6	5.9	6.2	6.5	6.6	1.22	1.39	0.36	0.30	8.3	7.6
F. test	**	*	*	*	**	**	**	**	**	**
LSD at 5%	0.3	0.3	0.3	0.3	0.11	0.08	0.04	0.02	0.4	0.2
D. F.test Interaction										
AX B	**	*	NS	*	NS	NS	*	NS	NS	NS
AXC	NS	NS	NS	NS	**	NS	NS	**	**	**
BX C	NS	NS	NS	NS	*	NS	NS	NS	NS	NS
AX BXC	NS	NS	NS	NS	*	**	*	NS	NS	NS

4- Effect of the interaction between storage periods and harvesting dates:

Results presented in Table 6 showed that the interaction between storage periods and harvesting dates had a significant effect on mean germination time, insect infection percentage and seed dry weight loss in the first and second seasons while it had different effects on seedling fresh weight and seedling dry weight only in the first season. On contrast, no significant effects were observed on the other traits. At the first storage period (0 month), harvesting wheat seed after 75 days from 50% heading produced the faster germination time (2.3 and 2.7 days). Meanwhile at the second storage period obtained seed from harvesting date 65 day from 50% heading produce the highest seedling dray weight (0.41 gm) in the second season.

Table 5: Averages of seed dry weight loss percentage, protein content and carbohydrate percentage of wheat seed as affected by storage periods, harvesting dates and seed classes as well as their interactions during 2007/2008 and 2008/2009 seasons.

Characters / Treatments	seed dry weight loss percentage		protein content		Carbohydrate percentage	
	2007/08	2008/09	2007/08	2008/09	2007/08	2008/09
A. Harvesting dates (days after 50% heading)						
45	2.3	1.9	11.0	11.2	63.9	64.7
55	2.0	1.7	12.7	13.0	65.9	66.4
65	1.6	1.4	13.1	13.3	66.1	66.5
75	1.3	1.1	13.2	13.4	65.4	65.4
F. test	**	**	**	**	**	**
LSD at 5%	0.3	0.2	0.2	0.2	0.4	0.3
B. Seed classes						
Foundation	1.9	1.5	12.5	12.7	65.3	65.8
Registered	1.8	1.5	12.5	12.7	65.3	65.8
Certified	1.7	1.5	12.5	12.7	65.3	65.8
F. test	NS	NS	NS	NS	NS	NS
LSD at 5%	-	-	-	-	-	-
C. Storage periods/ months						
0	0.0	0.0	12.2	12.4	65.7	66.0
3	0.9	0.6	12.5	12.8	65.2	65.7
6	4.5	3.9	12.9	13.0	65.0	65.5
F. test	**	**	**	**	**	**
LSD at 5%	0.3	0.1	0.1	0.2	0.2	0.2
D. F. test Interaction						
AX B	NS	NS	NS	NS	NS	NS
AXC	**	**	NS	NS	NS	NS
BX C	NS	NS	NS	NS	NS	NS
AX BXC	NS	NS	NS	NS	NS	NS

Table 6: Averages of mean germination time (day), seedling fresh weight (g), seedling dry weight (g), insect infection percentage and seed dry weight loss percentage of wheat seed as affected by the interaction between storage periods and harvesting dates during 2007/2008 and 2008/2009 seasons.

Characters / Treatments		Mean germination time (day)		Seedling fresh weight (g)		Seedling dry weight (g)		Insect infection percentage		Seed dry weight loss percentage	
		2007/08	2008/09	2007/08	2008/09	2007/08	2008/09	2007/08	2008/09	2007/08	2008/09
Storage period	Harvesting dates										
0 month	45 D.A. 50% H.	3.1	3.6	2.33	1.90	0.42	0.36	0.0	0.0	0.0	0.0
	55 D.A. 50% H.	2.8	3.1	2.43	2.28	0.46	0.39	0.0	0.0	0.0	0.0
	65 D.A. 50% H.	2.5	2.8	2.76	2.31	0.49	0.41	0.0	0.0	0.0	0.0
	75 D.A. 50% H.	2.3	2.7	2.70	2.16	0.45	0.38	0.0	0.0	0.0	0.0
3 months	45 D.A. 50% H.	3.0	3.3	1.29	1.50	0.40	0.29	6.0	4.6	1.5	0.8
	55 D.A. 50% H.	3.4	3.7	1.33	1.90	0.45	0.37	5.0	4.3	1.0	0.8
	65 D.A. 50% H.	3.3	3.6	1.37	1.98	0.45	0.39	3.4	3.3	0.6	0.5
	75 D.A. 50% H.	3.8	4.1	1.35	1.83	0.44	0.36	2.9	2.9	0.5	0.4
6 months	45 D.A. 50% H.	3.2	3.5	1.15	1.25	0.31	0.25	9.9	8.7	5.4	4.7
	55 D.A. 50% H.	3.4	3.7	1.22	1.42	0.38	0.29	8.8	8.0	4.9	4.4
	65 D.A. 50% H.	3.9	4.2	1.27	1.52	0.37	0.35	7.7	7.3	4.2	3.7
	75 D.A. 50% H.	3.5	3.8	1.23	1.37	0.36	0.29	6.9	6.3	3.5	2.8
F.test		**	**	**	NS	NS	**	**	**	**	**
LSD at 5%		0.40	0.66	0.19	-	-	0.03	1.17	0.48	0.54	0.34

After storage with 3 months lately harvesting date to 75 days from 50% heading result the lowest mean of insect infestation and seed dry weight loss. Finally after 6 months from storage earlier harvesting date (45 days from 50% heading) resulted the highest mean of insect infestation and seed dry weight loss in the two seasons. These results are similar with those reported by Mersal (2005).

5- Effect of the interaction between storage periods and seed classes:

Results presented in Table 7 showed that the interaction between storage periods and seed class had a significant effect on seedling fresh weight only in the first season. On contrast, no significant effects were observed on the other traits. At the first storage period (0 month), the highest mean of seedling fresh weight (2.68 g) was obtained from foundation seed, whereas, the lowest value of seedling fresh weight (1.20 g) was produced after 6 months from storage of the certified seed only in the first season.

Table 7: Averages of seedling fresh weight (g) of wheat seed as affected by the interaction between storage periods and seed classes during 2007/2008 season.

Characters / Treatments	Seedling fresh weight (g)		
Storage periods/ seed classes	**Foundation**	**Registered**	**Certified**
0 month	2.68	2.47	2.53
3 months	1.29	1.37	1.34
6 months	1.21	1.24	1.20
F. test	*		
LSD at 5%	0.1		

Table 8: Averages of speed of germination, plumule length (cm), redicale length (cm), and seedling dry weight (gm) of wheat seed as affected by the interaction between harvesting dates and seed classes during 2007/2008 and 2008/2009 seasons.

Characters / Treatments		Plumule length (cm)		Redicale length (cm)		Seedling dry weight (gm)	
		2007/08	2008/09	2007/08	2008/09	2007/08	2008/09
harvesting dates	**seed classes**						
45 D.A. 50% H.	**Foundation**	6.04	6.23	6.44	6.68	0.39	0.31
	Registered	6.26	6.50	6.72	7.08	0.34	0.29
	Certified	6.13	6.23	6.74	6.59	0.41	0.31
55 D.A. 50% H.	**Foundation**	5.97	6.25	6.78	7.06	0.45	0.35
	Registered	6.53	6.74	6.73	7.13	0.44	0.34
	Certified	6.94	7.13	6.78	6.73	0.41	0.37
65 D.A. 50% H.	**Foundation**	6.58	6.66	6.74	6.86	0.43	0.39
	Registered	6.42	6.63	6.78	6.84	0.45	0.37
	Certified	6.04	6.32	6.58	7.05	0.44	0.38
75 D.A. 50% H.	**Foundation**	6.29	6.67	6.67	6.80	0.44	0.36
	Registered	6.28	6.36	6.78	6.70	0.40	0.33
	Certified	6.17	6.23	6.57	6.92	0.42	0.35
F.test		**	*	NS	*	*	NS
LSD at 5%		.64	.51	-	0.38	0.04	-

6- Effect of the interaction between harvesting dates and seed classes:

Results presented in Table 8 showed that the interaction between harvesting date and seed class had a significant effect on plumule length in the first and second seasons, radicale length in the second season and seedling dry weight in the first season. On contrast, no significant effects were observed on the other traits.

Table 9: Averages of speed of germination, germination energy, seedling fresh weight and seedling dry weight (g) of wheat seed as affected by the interaction among storage periods, harvesting dates and seed classes during 2007/2008 and 2008/2009 seasons.

Characters / Treatments			Germination energy		Seedling fresh weight (g)		Seedling dry weight (g)	
			2007/08	2008/09	2007/08	2008/09	07/2008	2008/09
Storage periods	Harvesting dates	seed classes						
0 month	45 D.A. 50% H.	Foundation	50.0	51.8	2.32	1.76	0.42	0.36
		Registered	71.0	72.8	2.14	1.77	0.38	0.34
		Certified	84.0	85.8	2.54	2.15	0.46	0.37
	55 D.A. 50% H.	Foundation	98.0	99.8	2.70	2.43	0.46	0.37
		Registered	84.0	86.3	2.28	2.22	0.48	0.36
		Certified	79.0	80.8	2.32	2.20	0.45	0.44
	65 D.A. 50% H.	Foundation	97.0	98.8	2.72	2.23	0.52	0.42
		Registered	96.0	97.8	2.76	2.40	0.48	0.40
		Certified	71.5	73.3	2.81	2.30	0.48	0.41
	75 D.A. 50% H.	Foundation	54.0	65.3	2.98	2.28	0.48	0.40
		Registered	99.0	100.0	2.69	2.17	0.41	0.36
		Certified	97.0	98.8	2.44	2.04	0.46	0.39
3 months	45 D.A. 50% H.	Foundation	63.8	65.5	1.29	1.66	0.46	0.31
		Registered	45.3	47.0	1.36	1.44	0.36	0.27
		Certified	32.5	34.3	1.23	1.40	0.39	0.30
	55 D.A. 50% H.	Foundation	62.8	64.5	1.29	1.88	0.44	0.37
		Registered	61.3	63.0	1.40	1.82	0.48	0.36
		Certified	65.0	66.8	1.29	2.00	0.44	0.37
	65 D.A. 50% H.	Foundation	56.0	57.8	1.29	2.00	0.42	0.40
		Registered	80.0	81.8	1.38	1.91	0.48	0.37
		Certified	74.0	75.8	1.45	2.01	0.47	0.39
	75 D.A. 50% H.	Foundation	56.3	58.0	1.29	1.82	0.46	0.37
		Registered	64.0	65.8	1.36	1.90	0.41	0.35
		Certified	62.8	64.5	1.39	1.78	0.45	0.36
6 months	45 D.A. 50% H.	Foundation	37.0	38.8	1.14	1.29	0.29	0.26
		Registered	41.0	42.8	1.17	1.22	0.28	0.25
		Certified	41.0	42.8	1.15	1.23	0.38	0.25
	55 D.A. 50% H.	Foundation	65.5	67.3	1.20	1.35	0.45	0.30
		Registered	56.5	58.3	1.24	1.43	0.35	0.29
		Certified	53.0	54.8	1.21	1.48	0.35	0.29
	65 D.A. 50% H.	Foundation	46.0	47.8	1.26	1.59	0.36	0.35
		Registered	62.5	64.3	1.29	1.47	0.39	0.35
		Certified	52.0	53.8	1.25	1.52	0.36	0.35
	75 D.A. 50% H.	Foundation	53.0	54.8	1.24	1.38	0.38	0.31
		Registered	50.0	51.8	1.26	1.38	0.38	0.28
		Certified	38.5	40.3	1.20	1.35	0.34	0.28
F.test			**	**	*	**	*	NS
LSD at 5%			28.4	26.6	0.2	0.3	0.07	-

At the first storage period (o month) harvesting the foundation seed class after 45 days from 50% heading produce the highest plumule length (6.04 and 6.23 cm) and radicale length (6.68 cm) meanwhile the registered seed class produced the lowest weight of dry seedlings (0.34 cm). Harvesting after 55 days from 50% heading the foundation seed class produce the highest dry weight of seedlings (0.45 cm), meanwhile the registered seed class produce the tallest redicale length (7.13 cm). On the other side the certified seed class produced the tallest plumule length (6.94 and 7.13 cm).

7- Effect of the interaction among storage periods, harvesting date and seed classes:

Results presented in Table 9 showed that the interaction between storage periods x harvesting dates x seed classes had a significant effect on germination energy and seedling fresh weight in the first and second seasons and seedling dry weight in the first season. On contrast, no significant effects were observed on the other traits. At the first storage period, the highest mean of germination energy (98.0 and 99.8) produced from foundation seed when harvested after 55 days from 50% heading meanwhile the highest seedlings dry weight produced from foundation seed class when harvested after 75 days from 50% heading in the first season meanwhile at the second season the highest seedlings fresh weight (2.43 cm) produced when harvested after 55 days from 50% heading. After 6 months from storage the lowest means of germination energy (37.0 and 38.0) and seedling fresh weight (1.14 cm) were produced from the foundation seed class when harvested after 45 days from 50% heading.

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تأثير درجات التقاوى ومواعيد الحصاد والتخزين على المحصول وجودة تقاوى القمح

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أقيمت تجربتان حقليتان في موسمي ٢٠٠٧/٢٠٠٨ و٢٠٠٨/٢٠٠٩ بمزرعة قسم المحاصيل - كلية الزراعة- جامعة المنصورة. تم تنفيذ التجربة الأولى فى تصميم قطع منشقة مرة واحدة فى اربع مكررات وذلك لدراسة تأثير استخدام درجات إكثار التقاوى المختلفة (أساس – مسجلة – معتمدة) و تأثير مواعيد الحصاد (٤٥ و٥٥ و٦٥ و٧٥ يوم من ٥٠% من طرد السنابل)على نمو ومحصول القمح صنف جيزة ١٦٨ وأقيمت تجربتان معمليتان بمعمل وحدة بحوث تكنولوجيا البذور بالمنصورة – محافظة الدقهلية بنظام التجارب العاملية في تصميم القطاعات الكاملة العشوائية في اربع مكررات وذلك لدراسة تأثير استخدام درجات اكثار التقاوى المختلفة (أساس – مسجلة – معتمدة) و تأثير مواعيد الحصاد (٤٥ و٥٥ و٦٥ و٧٥ يوم من ٥٠% من طرد السنابل) وتأثير فترات التخزين (صفر، ٣ و ٦ شهور) على الإنبات وقوة البادرات والإصابة الحشرية والفقد فى الوزن.

ويمكن تلخيص أهم النتائج فيما يلى:-

١- أوضحت الدراسة وجود فروق معنوية بين مواعيد الحصاد المختلفة فى صفات محتوى الرطوبة بالحبوب، عدد السنابل بالمتر المربع، وزن ٥ سنابل، عدد الحبوب بكل سنبلة، وزن حبوب السنبلة، وزن ١٠٠٠حبة ومحصول الحبوب فى كلا الموسمين. أدى حصاد القمح بعد ٦٥ يوم

من ٥٠% من طرد السنابل إلى الحصول على أعلى المتوسطات لصفات المحصول ومكوناته مثل عدد السنابل/م٢، وزن ١٠٠٠ حبة ومحصول الحبوب فى كلا الموسمين.

٢- أشارت النتائج إلى عدم وجود فروق معنوية بين درجات إكثار التقاوى على كل الصفات المدروسة وذلك فى كلا الموسمين. أعطت تقاوى الأساس أعلى النتائج فى معظم الصفات يليها التقاوى المسجلة والمعتمدة.

٣- لم يكن هناك فروق معنوية للتفاعل بين مواعيد الحصاد ودرجات إكثار التقاوى على كل الصفات المدروسة فى كلا الموسمين.

٤- أظهرت النتائج أن زيادة فترات التخزين كان لها تأثير معنوى على جميع الصفات المدروسة. فلقد أدى زيادة فترات التخزين إلى انخفاض فى نسبة الإنبات، سرعة الإنبات، قوة الإنبات، معدل الإنبات، طول الريشة سم، طول الجذيرسم، الوزن الرطب و الوزن الجاف للبادرات ومحتوى الكربوهيدرات بالبذور.

٥- أوضحت الدراسة أن هناك اختلافات معنوية بين مواعيد الحصاد المدروسة فى تأثيرها على صفات الإنبات وقوة البادرات وكذلك معدل الإصابة الحشرية، والفقد فى الوزن ومحتوى البذور من البروتين الكربوهيدرات فى كلا الموسمين وسرعة الإنبات فى الموسم الأول فقط.

٦- أوضحت الدراسة أن هناك اختلافات معنوية بين درجات إكثار تقاوى القمح فى الوزن الجاف للبادرات فى الموسم الثانى فقط وسجلت تقاوى الأساس والمعتمدة أعلى النتائج بينما سجلت التقاوى المسجلة أقل النتائج ولم يوجد أى تأثير معنوى لدرجات التقاوى على باقى الصفات المدروسة.

٧- أظهرت النتائج وجود فروق معنوية للتفاعل بين فترات التخزين ومواعيد الحصاد ودرجات إكثار التقاوى فى قوة الإنبات والوزن الرطب للبادرات فى كلا الموسمين والوزن الجاف للبادرات فى الموسم الأول فقط.

* توصى هذه الدراسة بزراعة تقاوى درجات الإكثار (المسجلة أو المعتمدة) والمنتجة تحت إشراف برنامج إنتاج التقاوى وأن يتم حصاد تقاوى القمح صنف (جيزة ١٦٨) بعد ٦٥ يوم من طرد ٥٠% من السنابل للحصول على أعلى محصول للحبوب وجودة تقاوى مع امكانية تخزين هذه البذور للموسم القادم والحصول على جودة تقاوى عالية وذلك تحت ظروف محافظة الدقهلية. \

قام بتحكيم البحث

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