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Induced Mutations in some Wheat (*Triticum aestivum* L.) Genotypes

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Abstract

This investigation was carried out to induce mutations in bread wheat (*Triticum aestivum* L.) at the Experimental and Research Farm, Faculty of Agriculture, Al-Azhar University. Two wheat genotypes treated with different concentration of di methyl sulfouxide and sodium azide. In general, treatment Misr-1 (sodium azide 4000 ppm) was more effective than another to induce mutation and gave mutant with early flowering (86.95 day) in M2 generation.

The highest grain yield/plant (50.3 g and 47.77g) were obtained from Sids 14 (Di- methyl sulfouxide 2000 ppm) and Misr 1 (Di methyl sulfouxide 2000 ppm) but untreated plant Sids 14 gave 37.43 g.. The variety (Sids 14) was more responsible than the other variety for induction of stable promising mutants according to final results at M2 especially high grain yield/plant.

Using of different mutagen treatment was effective tools to obtained new wheat genotypes, earliness and grain yield. We can use these new genotypes in breeding program.

***Keywords**: Wheat, Genotypes, Grain yield.*

Introduction

Wheat (*Triticum aestivum* L.). Is the most widely grown cereal crop in the world and one of the central pillars of global food security. About 651 to 730.3 million tons of wheat was produced from 217 million hectares in 2010 and 2017/2018 with productivity level of 3 t/ha^{-1} (FAO, 2010, FAO, 2019 and Braun *et al*. 2010). Wheat Is an important food crops of the world. It is a dietary mainstay for millions of people as it provides 50% caloric and protein requirements to a major population of the world.

The prime strategy in mutation breeding has been to upgrade the well adapted plant varieties by altering one or two major traits which limit their productivity or enhance their quality.. The genetic variability resulted from micro- mutation allows breeding of quantitative characters (Brojevic 1965). Sarkar (1986) indicated that estimated variation of the quantitative characters were higher for the M_3 generation than those of the M2 generation.

Chemical mutagenesis is regarded as in effective and important tool in improving the yield and quality characters of crop plants. In alkylating agents are very effective mutagens in higher plants.

Artificial induction of mutations by using of chemical mutagens such as radiation and chemicals are considered to be one of the useful tools for plant improvement by increasing of genetic variability in many plant species, especially the self-fertilized plants. (Sakin 2002; Servasta *et al.* 2009, Srivastava *et al*. (2011). Fatima K.G.AL-Nuaimi and Al-Shamma 2015, Okaz *et al*. 2016 and Al-Shamma and Mohammed (2018).

The main objective of the present investigation is to study the ef-

fect of DMS and sodium azide on the two Egyptian varieties (Sids 14 and Misr1). The aim of this work has been to select new varieties of wheat that are high grain yield/plant and early maturing as a promising mutant that could be used in breeding program to get.

Materials and Methods

The present study was carried out at the Experimental Farm Faculty of Agriculture, Al-Azhar University, Assiut branch during 2017/2018 and 2018/2019 growing seasons. The genotype used for mutagenic treatment were sids 14 and misr1. Three different concentrations of di methyl sulfouxide (1000ppm), (2000ppm) and (3000ppm) and sodium azide (2000 ppm), (4000ppm) and (6000ppm) were freshly prepared for conducting the mutagenic treatments. Three hundred seeds of wheat were soaked in distillated water for six hours except control treatment. The selected variants at the present study included apparent morphological characters, for days to 50% heading, and grain yield/plant. These variants were screened to isolate M1 and M2 generations.

Di Methile Sulfouxide

300 seeds from each variety were soaked in prepared aqueous solution of Di Methyl Sulfouxide of three different concentrations (1000 ppm (h1), 2000 ppm (h2) and 3000 ppm (h3) for 6 hours.

Sodium Azide:

300 seeds from each variety were soaked in prepared aqueous solution of sodium azide of three different concentrations (2000 ppm (h4), 4000 ppm (h5) and 6000 ppm (h6) for 6 hours.

Heritability is estimated by several methods that use different genetic populations and produced estimates that may vary. Common methods include the variance components method and parent-offspring regression. In this investigation we used the parent- offspring regression as estimate for heritability.

The significance was estimated by T test by comparison between groups (comparison between mutated plants with unmutated plants)**.**

Results and Discussion

At the first season of the investigation all mutagenic treatments induced mutants of different desired traits in this crop such as days to 50% heading and grain yield / plant.

Table (1) shows that chosen mutant in M1 generation after applying the mutagen treatments. It is clear from results in Table 1, that mutant differ from the original plants of different wheat genotypes in main characters i.e. grain yield/ plant and days to 50% heading. Results show that all treatments (Chemicals) have led to mutations in all wheat genotypes.

Table 1. List of mutants chosen in M_1 generation in 2017/2018 season.

Genotypes	m.n	Grain wheat/plant	Days to 50% heading
Sids (14) V1		38.41	84.65
Misr (1) V2		36.28	87.99
V1 h1	1	67.17	78
V1 h1	2	59.88	78
V1 h1	3	45.05	78
V1 h1	4	50.92	78
V1 h1	5	64.17	79
V1 h1	6	45	79
V1 h1	7	74.06	79
V1 h1	8	52.24	79
V1 h2	1	80.81	82
V1 h2	2	80.75	82
V1 h2	3	84.68	82
V1 h2	4	84.16	82
V1 h2	5	87.4	83
V1 h2	7	70.83	83
V1 h2	9	65.42	83
V1 h2	10	73.8	83
V1 h3	1	65.98	82
V1 h3	2	74.8	82
V1 h3	3	57.19	82
V1 h3	4	65.09	83
V1 h3	5	54.09	83
V1 h3	6	50.25	83
V1 h3	7	63.38	83
V1 h4	6	51.55	91
V1 h4	7	52.4	91
V1 h5	3	54.16	77
V1 h5	4	62.48	77
V1 h5	6	48.09	79
V1 h5	7	55.87	79
V1 h5	8	53.58	79
V1 h5	10	50.30	81

Table 1. Cont

Genotypes	m.n	Grain yield/ plant	Days to 50 % heading
V1 h6	1	66.29	77
V1 h6	3	48.55	77
V1 h6	5	42.86	81
V1 h6	6	68.87	81
V1 h6	9	52.40	83
V1 h6	10	59.2	85
V2 h1	1	41.95	79
V2 h1	2	39.96	79
V2 h1	3	53.37	79
V2 h1	4	49.91	79
V2 h1	5	58.67	79
V2 h1	7	37.100	81
V2 h1	8	43.59	81
V2 h1	9	41.48	81
V2 h1	10	49.59	80
V2 h2	1	37.71	87
V2h2	2	42.81	87
V2h2	4	38.45	87
V2h2	5	37.75	87
V2h2	6	39.06	87
V2h2	8	45.76	88
V2h3	1	39.65	83
V2h3	2	38.57	83
V2h3	3	36.95	83
V2h3	5	59.2	83
V2h3	8	54.16	83
V2 h3	9	62.48	83
V2h3	10	48.09	83
V2 h4	1	55.87	80
V2h4	2	53.58	80
V2h4	3	50.3	80
V2 h4	4	39.87	81
V2h4	5	39.97	82
V2h4	6	38.17	82
V2 h4	7	47.49	82
V2h4	8	48.97	82
V2h4	10	38.64	82
V2h5	1	90.82	80
V2h5	2	76.38	80
V2h5	3	95.05	82
V2h5	4	70.06	81
V2h5	5	67.88	81
V2h5	6	63.92	81
V2h5	7	79.04	81
V2h5	8	84.32	81
V2h5	9	72.89	81
V2 h5	10	61.58	81
V2 h6	1	85.26	78
V2 h6	2	72.61	78
V2 h6	3	65.52	80
V2 h6	4	69.26	80
V2 h6	5	72.72	80
V2 h6	6	74.97	80
V2 h6	7	73.81	80
V2 h6	8	67.08	81
V2 h6	9	65.29	81
V2 h6	10	78.57	81

Obtained plants in M_1 which shows in Table 1 were planted to get a second generation. The numbers of plants which maintain the mutations in M_2 are shown in Table 2.

Table 2. Number of plants which have mutation in different generation.

Chemical		
	M1	**M2**
V1 h1	8	5
V1 h2	8	5
V1 h3	8	6
V1 h4	7	2
V1 h5	6	3
V1 h6	8	3
V2 h1	9	4
V2 h2	6	4
V2h 3	7	3
V2 h4	9	3
V2 h5	10	6
V2 h6	10	2

Results in Table (2) shows that the numbers of plants which maintain of mutations until the third generation were 47 plants.

The means and variances of the mutants which cached from all mutagenic treatment were calculated and compared with that of the same number of plants representing control treatment for the two main traits i.e. grain yield/plant and days to 50% heading from sowing to flowering (Table 3).

Effect of mutagens on means, variance and heritability in narrow sense:

Results in Table (3) and Fig. 3 and 4 illustrated that variety No.2 was more response to chemicals treatment about flowering than another variety and its gave early flowering plants. $V2h_5$, and $V2h_6$ gave the earliest (86.95, and 88.33 day, respectively) plants its earlier 7.75 and 6.37 days, respectively, than untreated plants L_1 (94.7 day). In general, treatment v2 h5 was more effective than another to induce mutation and gave mutant with early flowering (86.95 day) in M2 generation.

All plants which maintain the mutations until M2 were surpassed untreated plants in grain yield/plant. The highest grain yield /plant (50.3 and 45.95g) was obtained from $V1h_2$ and v1h3 but untreated plant V1 gave 37.43 g. So, the increasing percentage from untreated plants was 34.38 and 21.53% respectively.

Variety No.2 occupied the second place in grain yield/plant. Where, both of $V2h_2$, $V2h_4$ and V2 h6 gave 47.70, 41.39 and 40.77 g. This means that $V2h_2$, $V2h_4$, 41.22 and V2 h6 increased 126.38% in grain yield/plant more than V2 which gave 32.5 g. This result coincides with Dhole *et al*. (2003) and Okaz *et al.* (2016).

Mutagen treatments have mostly increased the quantitative variations among the homozygous genotypes. Significant increase in quantitative variation was found for most of the characters in both M1 and M2 generations except for treatments V1h3, V2h3 and V2h4 for days to 50% heading in M1 generation and V1h4 and V1h5 for grain yield/plant in M2 generation. These significant increases reached about two folds of the untreated populations or more. The amounts of the induced variations were similar using the two chemical mutagens. Significant increase was detected for days to 50% heading and grain yield / plant. These results agreed with (Ahmed 2011 and Okaz *et al.* 2016) when used electric shock and di methyl sulfouxide on wheat and safflower. On the other hand, (Hawash and AL-Shmma (2016) don't agree with present results when used electric shock. Also, don't agree with Irfac and Nawab (2001), Harvet (1961), Muhammad (1962), Hanafy *et al*. (2006) and AL-Shmma and Hawash 2018 who observed delay in regimentation in wheat species after treatment with gamma, X rays, external electric field and heat shock.

Reddy and Revathi (1992) who found that the mutation frequency increased with duration, concentration of the mutagen treatment, and was higher in the combination of treatments treating seeds of barley and wheat individually and in combination with gamma ray, 0.5 ethyl methane sulphonate (EMS) and sodium azide.

The parent-offspring regression coefficients values (Table 4) represent heritability in narrow sense reached 0.93 and 0.69 for days to 50% heading and grain yield /plant of M_2 generation respectively. This result coincides with Okaz *et al*. (2016).

Table 3. Means and variances for wheat genotypes under different treatments of mutagenic through generations.

Characters / Varieties		Days to 50% heading				Grain yield / plant			
		Mean ± S.E		VARIANCE		Mean ± S.E		VARIANCE	
		M1	M2	M1	M2	M1	M2	M1	M2
V1	H1	79.35	91.52	3.919*	44.19*	57.31	41.39	31.35*	80.10*
V1	H2	85.42	89.42	1.469*	15.48*	78.74	50.03	51.48*	62.28*
V1	H3	87.00	97.14	0.593	26.73*	61.55	45.49	52.86*	66.44 *
V1	H4	87.60	92.52	5.99*	5.963*	53.37	38.77	54.38*	2.018
V1	H5	88.06	92.47	5.27*	5.297*	54.08	36.17	20.69*	3.122
V1	H6	88.94	94.00	4.51*	15.90*	41.54	41.19	11.97*	38.22*
V1	con.	84.65	90.88	0.956	3.109	38.41	37.43	2.146	2.089
V2	H1	88.64	92.83	1.319*	6.616*	46.18	39.87	44.56*	38.72*
V2	H2	83.85	91.38	1.669*	3.092*	41.55	47.71	16.88*	54.79*
V2	H3	89.09	95.95	0.167	23.37*	39.09	38.41	26.60*	14.752*
V2	H4	90.59	93.04	0.823	31.56*	60.18	41.39	16.299*	28.09*
V2	H5	81.08	86.95	1.227*	19.37*	78.25	39.52	90.22*	23.105*
V2	H6	89.36	88.33	2.16*	14.69*	63.89	40.77	34.81*	42.77*
V2	con.	87.99	94.70	1.00	2.706	36.28	32.50	1.145	2.185

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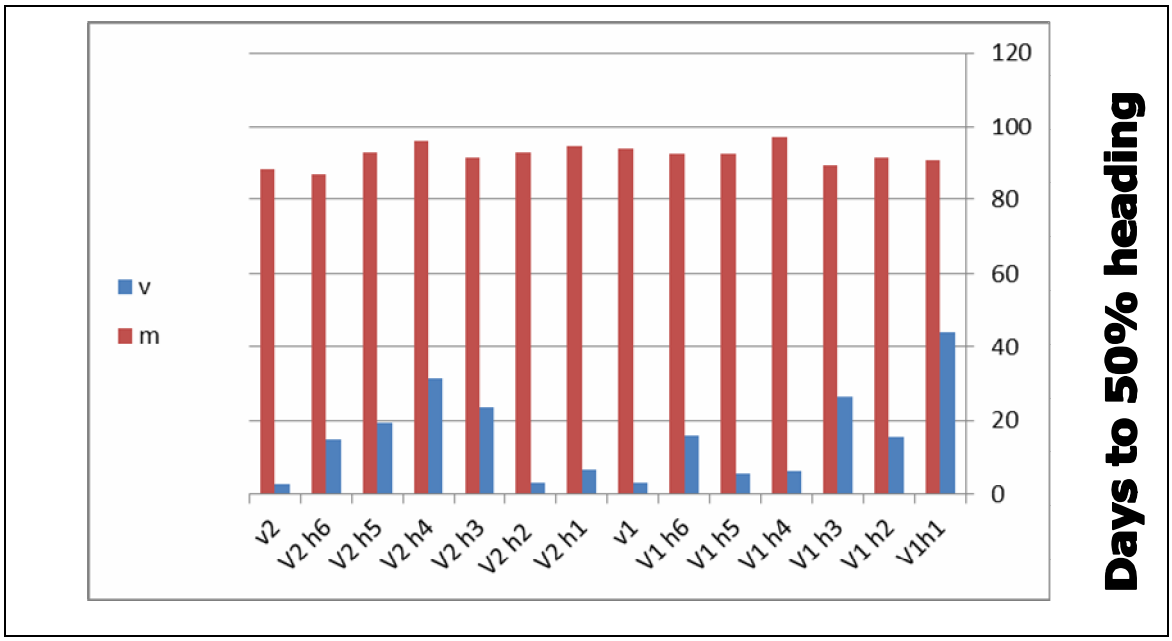

Fig 1. Days to 50% heading of wheat genotypes under different chemical treatments

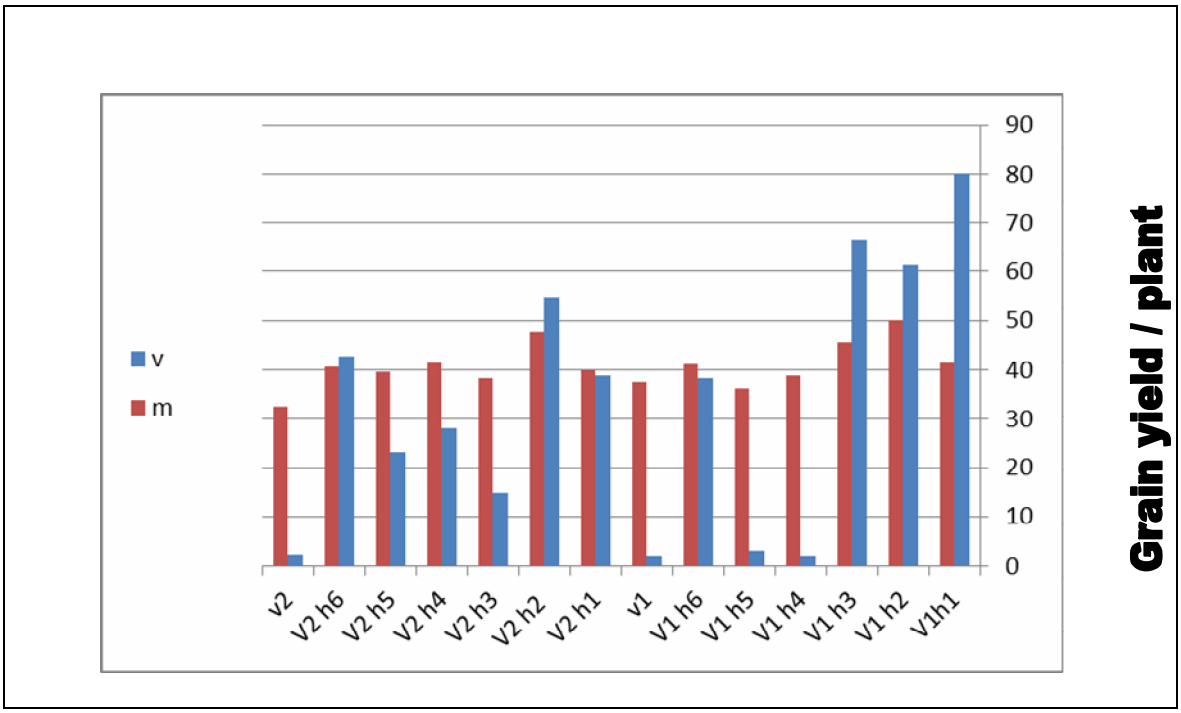

Fig. 2. Grain yield / plant of wheat genotypes under different chemical treatments

Table 4. The morphological variations and parent-offspring regression in mutated plants derived from chemicals treatments.

Character / Genotype	m.n	days to 50% heading		Grain yield/plant	
		m1	m2	m1	m2
v1h1	3	78	89	67.17	53.64
	4	78	83	59.88	41.93
	6	78	88	54	41.87
	7	78	85	50.92	50.30
v1h2	1	79	81	64.17	42.99
	2	79	81	55.22	46.88
	3	79	81	53	64.63
	4	79	81	52.24	48.76
v1 h3	1	82	91	80.81	44.04
	4	82	90	80.75	45.87
v1 h4	2	82	90	84.68	38.78
	5	82	91	84.16	55.28
v1h5	3	83	91	87.4	40.93
	6	83	91	70.83	37.04
vv1h6	1	83	90	65.42	55.43
	3	83	88	73.8	40.07
	4	82	88	65.98	37.27
	6	82	88	74.8	37.35
	7	82	90	57.19	34.56
v2 h1	1	83	90	65.09	38.91
	3	83	91	54.09	35.00
	4	83	91	50.25	35.07
	5	83	94	63.38	49.91
	6	77	92	64.83	36.57
	7	77	91	76.29	43.96
v2h2	1	79	94	39.83	34.33
	2	79	90	48.55	35.33
	3	79	94	41.86	36.17
	4	81	91	68.87	45.59
	5	77	90	39.98	48.98
	6	77	91	52.4	33.30

Table 4. Cont.

Characters / Genotype	m.n	days to50% heading		Grain yield/ plant	
		m1	m2	m1	m2
V2h3	7	81	91	59.2	59.2
v2 h3	5	81	91	54.16	54.16
	6	83	91	62.48	62.48
	7	79	91	48.09	48.09
v2 h4	2	79	90	55.87	55.87
	3	79	88	53.58	53.58
	5	79	88	50.3	50.3
	7	79	90	39.87	39.87
v2h5	1	81	92	39.97	39.97
	2	81	79	38.17	38.17
	3	81	90	47.49	47.49
	4	80	89	45	45
	5	83	91	38.74	38.74
	6	83	90	65.44	65.44
	7	83	85	59.2	67.22
v2h6	1	83	85	85.26	59.2
	2	83	84	72.61	54.16
	3	83	81	65.52	62.48
	6	85	89	74.97	48.09
	7	85	84	73.81	55.87
V1		84.65	90.88	38.41	37.43
V2		87.99	94.70	36.28	32.5
Regression coefficient			0.93		0.75

Conclusion:

Using of different mutagen treatment was effective tools to obtain new wheat genotypes, earliness and grain yield. We can use these new genotypes in breeding program.

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استحداث الطفرات في بعض الطرز الوراثية في قمح الخبز

بركات حسن أحمد محمد

قسم المحاصيل- كلية الزراعة - جامعة الأزهر- فرع أسيوط

الملخص

أجرى هذا البحث بالمزرعة التجريبية البحثية بكلية الزراعة جامعة الأزهر– فرع أسيوط خلال موسمين ٢٠١٧ /٢٠١٨ ، ٢٠١٨/٢٠١٩ لمعرفة تأثير اثنين من المطفرات الكيميائية الداي ميثيل سلفوكسيد والصوديوم آزيد علي بعض الصفات المظهرية في صنفين من قمح الخبز و تم استخدام الصوديوم آزيد بتركيزات(٢٠٠٠ ، ٤٠٠٠ ، ٦٠٠٠ جزء فى المليون)، واستخدم الداى ميثيل سلفوكسيد بتركيزات (١٠٠٠ ، ٢٠٠٠ ، ٣٠٠٠ جزء فى المليون).

أكدت النتائج أن الصنف سدس ١٤ كتركيب وراثي كان أكثر استجابه لاستحداث الطفرات عن الصنف مصر١ فيما يتعلق بالمحصول العالى.

أبكر النباتات من حيث التزهير (٨٦,٩٥ يوم) تم الحصول عليها من نباتات V2h2 في حين أعلي محصول حبوب تم الحصول عليه من نباتات V2h2, V1h2 (٥٠،٣ و ٤٧,٧٧ جرام) علي الترتيب.

أوضحت النتائج أنه يمكن باستخدام المطفرات الكيميائية الحصول علي طرز وراثية جديدة مبكرة في النضج وعالية في المحصول يمكن الإستفادة بها في برامج التربية والإنتخاب في أنسالها المتعاقبة.