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Effect of Sowing Dates on Potential Yield and Rust Resistance of Some Wheat Cultivars

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ABSTRACT

Wheat production influenced by stripe, stem and Leaf rusts all over the world and Egypt. In the preset study, effect of sowing dates (1^{st} November, 15^{th} November, 1^{st} December and 15^{th} December) on rust fungi causing agents and their impact on potential yield of nine wheat cultivars. (Giza 171, Shandaweel 1, Misr 1, Misr 2, Sakha 94, Sakha 95, Sids 12, Gemmeiza 11 and Gemmeiza 12) were evaluated during 2015/16 and 2016/17 seasons. Results showed that among sowing dates, rust severity was lower in early sowing (1^{st} November and 15^{th} November) and sever infection was in late sowing (1^{st} December and 15^{th} December). In the early sowing has paramount importance to combat rust severity effectively. Results also revealed that sowing in Nov.15 resulted in high number of days to heading, plant height, number of spikes/m2, biological yield, number of grains/spike and straw yield in both seasons. Meanwhile sowing in 1^{st} November resulted in high values of days to maturity and 1000 kernel weight. Wheat cultivars notably differed in all previous mentioned characters. Gemmeiza 11 was early in heading while Misr 2 was delayed in both seasons. Sids 12 and Gemmeiza 11 were early in maturity while Shandaweel 1 was vice versa. Sakha 95 cultivar surpassed other cultivars in grain yield/fed followed by Misr 2. Moreover Sakha 95 expressed high rust resistance followed by Shandaweel 1 and Giza 171 in both seasons. Results exhibited that rust disease severity has a strong negative correlation with grain yield and the interaction effects among sowing dates and different wheat cultivars were significant on all studied characters in both seasons. Finally, delaying sowing date caused considerable reduction in previous studied characters in both seasons and increase rust severity.

Keywords: Bread wheat cultivars, sowing dates, grain yield, rusts, severity.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is outstanding winter crop and main dietary food in Egypt. The cultivated area reached about 3.024 million feddan which produced 8.100 million tons and occupied 32 % of winter cultivated area (USDA 2017). Wheat provides 37 % of calories and 40 % of protein in the Egyptian food (Mujeeb *et al.,* 2008). Due to over population in developing countries the demand of wheat is keep on increasing (Rajaram, 2000 and Nagarajan 2005). Wheat production in Egypt is not sufficient by various factors among of them sowing dates and rust diseases. Sowing date is one of the major factors which determine the ability of the crop to stand against different environmental conditions. Optimum sowing date is vital to have the wheat crop in the field, when environmental conditions are suitable for fine growth. Also, late sowing decreased1000-kernel weight, number of kernels spike^{-1}and grain yield. (Mahgoub *et al.,* 2006) found reduction in grain yield at late sowing. The proper sowing date is during the last fifteen days of Nov. Also, in case of late sowing, growing Sakha 95 is recommended followed by Gemmeiza 11 and Giza 171. Different sowing dates affect disease severity, grain development, quality and yield of wheat crop. Delay sowing affects the crop performance in the field and ultimately produce low yield. Delay in sowing normally reduces individual plant growth and tiller production (Nazir and Fathi, 2004). Rusts are the most destructive diseases with a dynamic nature. Stripe rust pathogen (*Puccinia striiformis* f.sp. *tritici*) is the most important among all wheat rusts, favored by mild winters. In most wheat producing areas, yield losses caused by stripe rust have ranged from 10-70%. In addition stem rust (Black rust) caused by (*Puccinia graminis* f.sp. *tritici*) is a dangerous disease (Boyd *et al.,* 2013). Its favorable conditions are high temperature in hot days 25 to 30 ^{O}C, wet leaves by dew and rains, 15 to 20 ^{O}C at night (Chen 2005 and Leonard and Szabo 2005). Moreover, leaf rust caused by *Puccinia triticina* f.sp. *tritici* is the most common disease in wheat plants and makes loss yield due to low kernel weights and decreased kernel numbers per head (Goyeau *et al.,* 2007). Currently leaf rust caused major yield losses over enormous geographical regions and areas (Basnet *et al.,* (2014 a) and (2014 b). Consequently, this study was designed to test the performance of some wheat cultivars under different sowing dates as well as under biotic stresses caused by yellow, stem and leaf rusts.

MATERIALS AND METHODS

Two field experiments were conducted at Gharbyia Governorate, Gemmeiza Agricultural Research Station, Agricultural Research Center (ARC) during 2015/2016 and 2016/2017 growing seasons. The geographical position of the area is between 23^{o} 33/ N latitude and 89^{o} 44/ E longitude. The meteorological data of the experimental site revealed that the highest temperature was (36.5^{o}C) in May and the lowest in January. For the relative humidity the highest was in May (89%). Field experiments were carried out in a Randomized Complete Block Design with four replicates for every sowing date as a separate experiment. The experimental plot consisted of four sowing dates i.e. 1^{st}November, 15^{th}November, 1^{st}December and 15^{th} December. Nine wheat cultivars i.e. (Giza-171, Shandaweel-1, Misr-1, Misr-2, Sakha-94, Sakha-95, Sids-12, Gemmeiza-11 and Gemmeiza-12) were selected for our study. The source and pedigree of the nine studied cultivars in Table 1 were obtained from Field Crops Research Institute, Wheat Research Department, ARC. Wheat plot area was 10.5 m^2, 3.5 m in long, 3 m in wide and 20 cm apart. Seeds were sown at rate of 400 seeds/ m^2. Furthermore, soil chemical and physical analysis in both seasons as follows: the soil texture was clay, available nitrogen was 30.4 and 49.65 ppm, available phosphorus was 5.86 and 9.43 ppm, available potassium was 400 and 356.14, PH was 7.95 and 8.4 and organic matter was 0.50 and 0.78. Temperature and humidity are shown in Table 2.

Table 1. Wheat cultivars, released year and its pedigree.

cultivars	Released year	Pedigree
Giza 171	2013	Sakha93/Gemmeiza9 S 6-1GZ-2GZ-2GZ-0S
Shandaweel 1	2013	SITE/MO/4/NAC//3*PVN/3/MiRLO
Misr 1	2010	Oasis/SKauz//4* Bcn/3/2*pastor
Misr 2	2011	SKauz/Bav92SKauz/Bav92
Sakha 94	2004	OPATA / RAYON // KAUZ.CMBW 90Y3180-OTOPM-3Y-010M-010M-010Y-10M-015-OY-OAP-0S.
Sakha 95	2013	SKAUZ*2_SRMA-CMBW91MO2694P-0T0PY-7M-010Y -010M-010Y-5
Sids 12	2008	BUC//7C/ALD/5/MAYA74/ON//1160 - 147/3/BB/GLL/4/CHAT"S"/6/MAYA/VUL//CMH74A.630//4*SX
Gemmeiza 11	2011	Bow"s"/ Kvz // 7C / Seri 82 /3/ Giza 168 /sakha 61.CGM 7892 – 2GM-1GM-2GM-OGM
Gemmeiza 12	2012	OTUS/3/SA/THB//VEE/CMSS97Y00227S-5Y-010M-010Y-010M-2Y-1M-0Y-OGM

Table 2. Meteorological data of experimental site during 2015/2016 and 2016/2017 growing wheat seasons.

Months	Air temp. °C				Relative humidity			
	2015/16		2016/2017		2015/2016		2016/2017	
	Min	Max	Min	Max	Min	Max	Min	Max
November	12.8	26.0	14.6	28.3	37	85	38.2	84
December	10.9	21.3	11.3	23.6	36	86	36.3	86
January	8.2	20.4	10	21.8	28.7	85	29.4	86
February	9.4	22.7	9.7	23.9	23.5	84.3	25	85.4
March	10.8	25.9	10.9	26.1	34	83.2	33.6	84.6
April	13.1	30.3	12.3	32.4	22.4	85.4	24.1	86
May	17.4	34	18.2	36.5	22.3	87.2	23.5	89

Sources: Meteorological data, Gemmeiza Agricultural Research Station.

Disease score:

The rust intensities in wheat as based upon severity (percentage of rust infection on plants) and field response (type of disease reaction) outlined by Loegering (1959) was used for disease scoring. Severity was recorded as percentage, according to the modified Cobb Scale.

The Average Coefficient of Infection (ACI) of rust disease in wheat genotypes was calculated by following method developed by Peterson *et al.* (1948). The disease severity and host response data were often combined into a single value called coefficient of infection (C.I.). The different ACI readings, was calculated as measure of disease resistance. Data was subjected to analysis of variance (ANOVA) and Least Significant Difference (LSD 5%) used to compare the means for all the variables within the experiment (Gomez and Gomez, 1984).

Yield parameters estimated were:

Days to heading: days from sowing to 50 % flowering, days to maturity: from sowing to physiological maturity, plant height (cm): measured from the soil surface to the top of the spike of main stem, number of spikes/m^2: estimated by counting all spikes per square meter from each experimental unit harvest, biological yield. Grain yield: plants of the center area of each plot were harvested, tied, threshed and grain yield was estimated and converted to ardb/feddan (one ardb = 150 kg of wheat grain and one feddan= 4200 m^2), number of grains/spike: average number of grains formed on 10 spikes, randomly chosen, 1000 kernel weight: averages of three replications each contained 1000 grains of each variety, were weighted with a sensitive balance to the nearest gram and Straw yield (kg/fed) was estimated using the same steps for grain yield and converted to Kg /fed.

RESULTS AND DISCUSSION

Assessment of stripe, stem and leaf rust disease severity:

Wheat is the most important cereal crop in Egypt and have vital place in Agriculture. To obtaining the highest yield as well as ameliorate the ill the effect of diseases, crop sowing at its ideal time is necessary (Pfender 2004).

The results in Tables 3 and 4 explain the effect of sowing dates on rust severity and average coefficient of infection (ACI). Stripe rust severity was higher than the two other rusts which ranged from 20-90 during the two successive seasons in all treatments. Whereas leaf and stem rusts were low in severity except for wheat **cvs.** Gemmeiza11, Misr1 and Misr2 during 2016 and 2017 growing seasons.

Table 3. Effect of sowing dates and wheat cultivars on rust severity during 2015/2016 and 2016/2017 growing seasons.

Treatments	Yellow rust		Leaf rust		Stem rust	
	2015	2016	2015	2016	2015	2016
	A. Sowing date					
Nov. 1	30.00	32.22	3.33	3.33	1.66	2.22
Nov. 15	34.44	36.66	5.66	6.11	6.66	7.77
Dec. 1	45.55	50.00	8.22	7.88	12.22	11.55
Dec. 15	54.44	61.11	12.44	14.22	19.00	20.44
F test	**	**	NS	*	**	**
LSD 5%	4.49	5.60	-	7.56	8.51	8.80
	B. Varieties					
Giza 171	35.00	37.50	1.25	1.00	1.00	1.00
Shandaweel 1	35.00	42.50	1.75	3.50	0.00	0.00
Misr 1	37.50	37.50	0.00	0.00	30.00	35.00
Misr 2	45.00	47.50	3.75	2.00	31.25	30.00
Sakha 94	42.50	35.00	3.00	2.75	12.00	10.00
Sakha 95	27.5	32.50	1.25	0.75	0.00	0.00
Sids 12	60.0	70.00	1.50	1.00	10.00	15.00
Gemmeiza 11	50.00	57.50	52.50	57.50	4.50	3.50
Gemmeiza 12	37.50	45.00	1.75	2.50	0.25	0.00
F test	**	**	**	**	**	**
LSD 5%	6.73	8.40	10.33	11.34	12.76	13.19

Regarding to the effect of sowing dates on (ACI), it is evident from the results that November sowing date showed least development of rust disease compared with December sowing date during the two growing seasons. There was significant effect of date of sowing on average coefficient of infection. ACI was higher in late sowing conditions comparing to normal sowing condition (Table 4). Meanwhile the lowest values of ACI were obtained from sowing on 1st and 15th November. Data regarding ACI of stripe rust revealed that Sids12 and Gemmeiza11 were the most affected cvs. with ACI (50, 60 and 40, 40) while Sakha-95 was the lower susceptible cv. showing ACI of (20, 30), on the other hand the least values of ACI for leaf rust and stem rust were for Giza-171(0, 0) at sowing date 15th November during 2016 and 2017 seasons, respectively. In addition at sowing date 1st of

December ACI of stripe rust showed intermediate values ranged from 30 to 80 in second season. While, ACI for leaf rust it was less than that of stripe rust on all tested cultivars. Estimated ACI for stem rust ranged from 30 to 40, exhibit the highest values. High disease severity was observed on wheat plants sown on 15thDecember for all wheat cultivars. Calculated ACI of stripe rust showed that, Sids12, was the highest cv. during 2016 and 2017 seasons. Whereas, ACI of leaf rust reveled that, Gemmeiza-11, was the highest cv. during 2016 and 2017 seasons. Grain weight was the most affected yield component. Negative correlation was observed between disease severity and kernel weight. It can be concluded that in late sowing condition, the environmental conditions were suitable for disease progress. It might be the fact that plants of late sowing appear to be faced by warm vapors and high wind velocities which may result in the release of more spores that prevails at the late sowing condition.

Table 4. Effect of sowing dates on yellow, leaf and stem rust severity and their ACI of some wheat cultivars during 2015/2016 and 2016/2017 growing seasons.

Sowing dates	Wheat genotypes	Yellow rust				Leaf rust				Stem rust			
		2015/16		2016/17		2015/16		2016/17		2015/16		2016/17	
		RS	ACI	RS	ACI	RS	ACI	RS	ACI	RS	ACI	RS	ACI
1st November	Giza 171	30S	30	30S	30	0	0	0	0	0	0	0	0
	Shandaweel 1	20S	20	30S	30	0	0	0	0	0	0	0	0
	Misr 1	30S	30	30S	30	0	0	0	0	10S	10	10S	10
	Misr 2	30S	30	40S	40	0	0	0	0	5S	5	10S	10
	Sakha 94	30S	30	20S	20	0	0	0	0	0	0	0	0
	Sakha 95	20S	20	20S	20	0	0	0	0	0	0	0	0
	Sids 12	50S	50	50S	50	0	0	0	0	0	0	0	0
	Gemmeiza 11	30S	30	40S	40	30S	30	30S	30	0	0	0	0
	Gemmeiza 12	30S	30	30S	30	0	0	0	0	0	0	0	0
15th November	Giza 171	30S	30	30S	30	0	0	0	0	0	0	0	0
	Shandaweel 1	30S	30	40S	40	5R	1	10R	2	0	0	0	0
	Misr 1	30S	30	30S	30	0	0	0	0	20S	20	30S	30
	Misr 2	40S	40	40S	40	9	9	5MR	2	20S	20	20S	20
	Sakha 94	40S	40	20S	20	0	0	5R	1	10MS	8	10MS	8
	Sakha 95	20S	20	30S	30	0	0	0	0	0	0	0	0
	Sids 12	50S	50	60S	60	0	0	0	0	10S	10	10S	10
	Gemmeiza 11	40S	40	40S	40	40S	40	50S	50	5MR	2	5MR	2
	Gemmeiza 12	30S	30	40S	40	5R	1	0	0	0	0	0	0
1st December	Giza 171	40S	40	40S	40	5R	1	0	0	0	0	5MR	2
	Shandaweel 1	40S	40	50S	50	5MR	2	10MR	4	0	0	0	0
	Misr 1	40S	40	40S	40	0	0	0	0	40S	40	40S	40
	Misr 2	50S	50	50S	50	5MR	2	5MR	2	40S	40	30S	30
	Sakha 94	50S	50	40S	40	10MR	4	5MR	2	20MS	16	10MS	8
	Sakha 95	30S	30	30S	30	5R	1	5R	1	0	0	0	0
	Sids 12	60S	60	80S	80	5MR	2	0	0	10S	10	20S	20
	Gemmeiza 11	60S	60	70S	70	60S	60	60S	60	10MR	4	10MR	4
	Gemmeiza 12	40S	40	50S	50	5MR	2	5MR	2	0	0	0	0
15th December	Giza 171	40S	40	50S	50	5MS	4	5MS	4	10MR	4	5MR	2
	Shandaweel 1	50S	50	50S	50	5MS	4	10MS	8	0	0	0	0
	Misr 1	50S	50	50S	50	0	0	0	0	50S	50	60S	60
	Misr 2	60S	60	60S	60	10MR	4	10MR	4	60S	60	60S	60
	Sakha 94	50S	50	60S	60	20MR	8	20MR	8	30MS	24	30MS	24
	Sakha 95	40S	40	50S	50	10MR	4	5MR	2	0	0	0	0
	Sids 12	80S	80	90S	90	10MR	4	10MR	4	20S	20	30S	30
	Gemmeiza 11	70S	70	80S	80	80S	80	90S	90	30MR	12	20MR	8
	Gemmeiza 12	50S	50	60S	60	10MR	4	20MR	8	5R	1	0	0
LSD 5%		-	13.47	-	16.79	-	20.66	-	22.69	-	25.53	-	26.38

RS= Rust Severity; ACI= The Average Coefficient of Infection; R = Resistant; MR = Moderately resistant; S = Susceptible; MS = Moderately susceptible

Sowing date effects on yield

Highly significant differences among sowing dates were detected regarding studied characters i.e. days to 50% heading, days to maturity, plant height, spikes/m^2, biological yield, grain yield, number of grains/spike, 1000 kernel weight and straw yield in both seasons. Data presented in Tables (5 and 6) indicated that sowing in 15th November was the shorter in heading. This might be due to that heat units required for wheat heading were reached when sowing in 15th November faster than other sowing dates. However, days to maturity, significantly reduced at sowing in 15th November. This might be due to high temperature and dry weather after heading. Sowing date had significant effect on plant height at harvest, tallest plants in both seasons were those of sowing in 15th November. Moreover, sowing date had significant effect on grain yield/fed. The highest grain yield was obtained with sowing in 15th November during the two seasons. Sowing in 1st November caused yield drop estimated by about 6.35% and 6.09% in both seasons, while sowing at Dec.1 caused 14.18 % and 14.08 % reduction in two seasons and delay sowing toDec.15 caused yield reduction about 40.54 % and 39.09 % compared with sowing in Nov.15 in both seasons, respectively. This might back to grain–filling process that harmfully affected by high temperatures and kernels reaching to maturity stage before complete filling. Regarding spikes/m^2, sowing in Nov.15 gave the highest number of spikes/m^2 comparing other sowing dates. Timing of initiation of vegetative and reproductive organs depends upon temperature and photoperiod, but the survival and subsequent size of such organs is dependent upon the supply of assimilates. (Satorre and Slafer, 1999) showed that sufficient grain sitting initiated and sufficient assimilates depend on ideal sowing date. Tawfelis (2006), Menshawy (2007 a) and (2007 b) and (Elkalla *et al.,* 2010) reported that late sowing reduced number of days to maturity, 1000-kernel weight, grain and straw yields.

Table 5. Effect of sowing dates and wheat cultivars on heading date, maturity, plant height, spikes/m^2 and biological yield.

Treatments	Heading (Days)		Maturity (Days)		Plant height (Cm)		Spikes/ m^2		Biological yield (Kg)	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
A. Sowing date										
Nov. 1	93	97	159	162	119	121	353	345	23.44	22.17
Nov. 15	99	102	155	158	123	123	355	347	26.04	24.58
Dec.1	98	101	148	152	116	116	315	313	22.77	21.81
Dec.15	92	95	140	142	114	114	288	287	17.58	16.42
F test	**	**	**	**	**	**	**	**	**	**
LSD 5%	0.63	0.53	0.48	0.32	0.75	0.76	12.31	6.28	1.346	1.084
B. Varieties										
Giza 171	97	100	152	155	118	118	318	311	22.16	20.76
Shandaweel 1	96	99	154	156	114	112	349	345	22.78	21.50
Misr 1	91	95	150	153	119	120	337	332	21.98	20.81
Misr 2	103	107	154	157	120	122	337	331	23.958	22.57
Sakha 94	95	98	150	152	118	119	317	314	20.86	20.30
Sakha 95	100	103	150	152	119	119	329	323	23.20	21.90
Sids 12	92	94	148	151	117	118	314	309	21.89	20.56
Gemmeiza 11	90	93	148	151	118	118	319	314	22.14	20.87
Gemmeiza 12	96	99	150	153	118	119	331	328	23.15	21.93
F test	**	**	**	**	**	**	**	**	**	*
LSD 5%	0.77	0.82	0.78	0.83	0.85	0.95	8.15	8.86	1.663	1.332
C. Interactions										
AxB	**	**	**	**	**	**	**	**	NS	NS

Table 6. Effect of sowing dates and wheat cultivars on yield and yield component during 2015/2016 and 2016/2017 seasons.

Treatments	Grain yield (Ardb/Fed)		No of grains spike^{-1}		1000 Kernel weight (gm)		Straw yield (Kg/Fed)	
	2015	2016	2015	2016	2015	2016	2015	2016
A. Sowing date								
Nov. 1	8.347	8.170	72	71	57.71	57.31	15.09	14.00
Nov. 15	8.913	8.700	76	76	53.47	53.31	17.13	15.88
Dec. 1	7.649	7.475	61	60	48.58	47.72	15.12	15.29
Dec. 15	5.299	5.299	59	59	37.47	38.01	12.28	12.28
F test	**	**	**	**	**	**	**	**
LSD 5%	0.254	0.401	1.36	1.29	0.925	1.087	1.581	1.378
B. Varieties								
Giza 171	7.547	7.444	65	65	50.89	51.97	14.61	13.92
Shandaweel 1	7.591	7.330	67	65	43.46	43.17	15.19	14.67
Misr 1	7.444	7.285	67	67	44.57	43.83	14.54	14.02
Misr 2	7.865	7.777	68	69	44.27	43.20	16.09	15.40
Sakha 94	7.182	7.142	61	61	46.53	46.29	13.68	13.36
Sakha 95	7.886	7.723	65	63	48.06	47.34	15.31	14.75
Sids 12	7.345	7.375	71	71	58.01	58.04	14.55	13.68
Gemmeiza 11	7.632	7.340	72	72	57.35	56.73	14.51	14.22
Gemmeiza 12	7.476	7.283	65	65	50.64	51.24	15.67	15.25
F test	NS	NS	**	**	**	**	NS	NS
LSD 5%	-	-	1.512	1.788	1.955	1.217	-	-
C.Interactions								
AxB	NS	NS	**	**	**	**	NS	NS

Cultivars performance

The results in Tables (5 and 6) clearly showed that the tested cultivars of Wheat significantly varied for averages of days to heading, days to maturity, plant height, spikes/m2, biological yield, grain yield, number of grains/spike, 1000 kernel weight and straw yield in both seasons. Gemmeiza 11 was the earliest cultivar in days to heading (90 and 93 days) in both seasons, while Misr 2 was the latest one (103 and 107 days). Misr 2 was the longest of days to maturity (154 and 157 days) in both seasons while, Gemmeiza 11 and Sids 12 shortest days to maturity (148 and 151 days). Misr 2 cultivar significantly exceeded the other studied cultivars in plant height 120 and 122 cm. Sakha 95 cultivar came in the second rank 119 and 119 cm in both seasons. While, the lowest was recorded by Shandaweel 1 114 and 112 cm. Shandaweel 1 cultivar significantly exceeded the other studied cultivars in spikes/m^2 (349 and 345) and Misr 1 came in the second rank and recorded 337 and 332. While, Giza 171 cultivar produced the lowest spike/m^2 (318 and 311) in both seasons. The differences between wheat cultivars in spikes/m^2 might be due to the genetical factors and heredity variation among the eleven wheat cultivars. Misr 2 cultivar significantly produced highest grain yield 7.856 and 7.777 ardb/fed. Sakha 94 produced the lowest yield 7.182 and 7.142 ardb/fed in both seasons respectively. These variations among genotypes might partially reflect their different genetic backgrounds. This might be attributed to these cultivars include new bread wheat cultivars and old cultivars selected based on their high yielding potential and adaptability for sowing dates.

Interaction effects

The interaction between sowing dates and wheat cultivars significantly affected days to 50% heading, days to maturity, plant height, spike/m^2, no of grains/ spike and 1000 kernel weight as illustrated in Tables 7, 8 and figure 1. The earliest heading genotype was Gemmeiza 11 (87 and 90 days) at sowing in Dec.15 in both seasons. On the other hand, the latest was Misr 2 up to Nov.15 and Dec.1 (105 and 109 days) in both seasons. Significant differences between sowing dates and wheat cultivars in days to heading might be due to sensitive to photoperiod response. Misr 2 was the longest of days to maturity (160 and 166 days) at sowing in Nov.1 in both seasons while, Sids 12 shortest days to maturity (136 and 139 days) followed by Sakha 95 and Gemmeiza 11 (137 and 140) in both seasons. Tallest plant height was recorded with Nov.15 and sown Misr 1 cultivar 125 cm in both seasons. Highest spikes/m2 was recorded with sowing in Nov.15 and Shandaweel 1 cultivar 406 and 405 respectively. Highest no of grains/spike 84 and 83 when sowing in Nov.15 with Sids 12. Highest 1000 kernel weight was recorded with sowing in Nov.1 and Gemmeiza 11 cultivar 65.79 in season one and Sids 12 (66.22) in season two while lowest 1000 kernel weight was at sowing in Dec. 15 which recorded 32.82 with Giza 171 in season one followed by Misr 2 in season two. Kernel weight decreases gradually with delay sowing.

Table 7. Interaction between sowing dates and wheat cultivars on heading, maturity and plant height, during 2015/2016 and 2016/2017 seasons.

Sowing dates	Wheat cultivars	Heading		Maturity		Plant height	
		2015 /2016	2016 /2017	2015 /2016	2016 /2017	2015 /2016	2016 /2017
1st Nov.	Giza 171	89	91	159	162	115	115
	Shandaweel 1	88	91	160	163	115	114
	Misr 1	92	96	159	161	121	124
	Misr 2	104	109	163	166	121	126
	Sakha 94	95	96	158	161	121	124
	Sakha 95	99	104	161	165	121	125
	Sids 12	91	94	157	160	118	120
	Gemmeiza 11	88	92	155	157	119	121
	Gemmeiza 12	94	98	159	162	118	121
15th Nov.	Giza 171	102	106	159	163	122	122
	Shandaweel 1	101	105	160	162	118	116
	Misr 1	94	97	152	156	125	125
	Misr 2	105	109	160	164	124	125
	Sakha 94	97	102	153	156	124	124
	Sakha 95	104	107	156	158	123	122
	Sids 12	94	96	151	154	123	122
	Gemmeiza 11	93	97	152	155	123	123
	Gemmeiza 12	100	103	154	157	124	124
1st Dec.	Giza 171	101	105	149	153	117	119
	Shandaweel 1	101	104	151	154	114	108
	Misr 1	92	95	149	152	117	118
	Misr 2	105	109	150	155	119	120
	Sakha 94	96	99	148	152	115	115
	Sakha 95	102	105	145	147	116	114
	Sids 12	93	96	146	150	115	116
	Gemmeiza 11	92	95	147	150	116	115
	Gemmeiza 12	97	100	148	152	116	117
15th Dec.	Giza 171	95	99	142	145	118	117
	Shandaweel 1	94	98	143	143	110	111
	Misr 1	87	91	142	144	114	114
	Misr 2	97	100	142	144	116	116
	Sakha 94	92	95	139	141	113	113
	Sakha 95	95	98	137	140	114	115
	Sids 12	88	92	136	139	114	114
	Gemmeiza 11	87	90	137	140	114	114
	Gemmeiza 12	92	95	139	143	113	114
LSD 5%		3.1	3.3	3.2	3.3	3.5	3.8

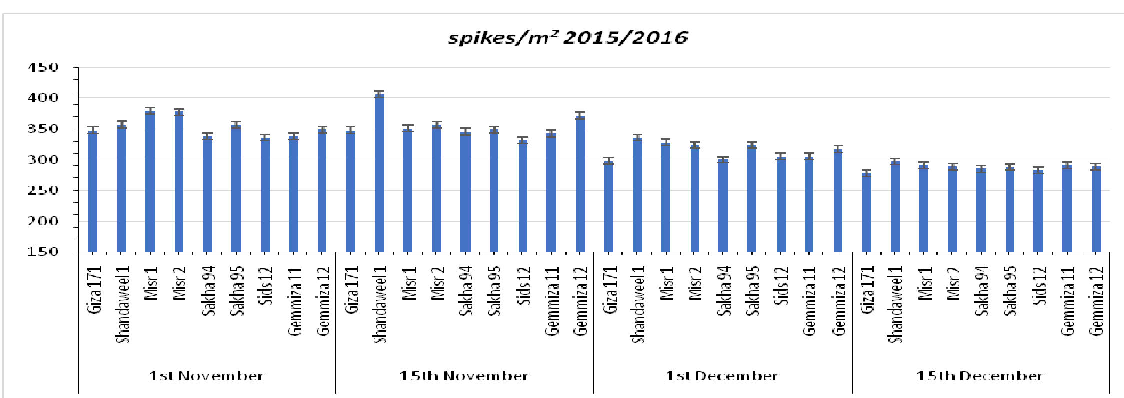

Fig. 1. spikes m^{-2} as affected by sowing dates and wheat cultivars

Table 8. Interaction between sowing dates and wheat cultivars on spikes/m^2, no of grains/spike and 1000 kernel weight during 2015/2016 and 2016/2017 seasons.

Sowing dates	Wheat Cultivars	Spikes/m^2		No grains/spike		1000 kernel weight (gm)	
		2015/2016	2016/2017	2015/2016	2016/2017	2015/2016	2016/2017
1stNov.	Giza 171	347	333	68	66	63.91	63.38
	Shandaweel 1	357	352	69	67	49.37	48.55
	Misr 1	379	378	73	74	56.05	55.06
	Misr 2	378	377	73	74	55.61	54.75
	Sakha 94	338	331	70	70	53.95	53.82
	Sakha 95	356	346	73	72	55.20	54.34
	Sids 12	336	323	77	77	63.97	66.22
	Gemmeiza 11	338	327	76	77	65.69	64.32
	Gemmeiza 12	349	339	68	67	55.66	55.39
15thNov.	Giza 171	347	342	70	72	57.07	56.88
	Shandaweel 1	406	405	72	71	47.97	47.93
	Misr 1	351	341	76	76	46.77	46.36
	Misr 2	356	348	77	78	46.55	45.87
	Sakha 94	345	338	71	72	48.99	49.23
	Sakha 95	349	334	76	75	51.33	50.55
	Sids 12	332	322	82	82	65.01	65.02
	Gemmeiza 11	343	330	84	83	62.13	62.01
	Gemmeiza 12	371	369	74	74	55.47	55.97
1stDec.	Giza 171	298	296	62	61	49.74	48.85
	Shandaweel 1	336	334	63	62	43.15	42.83
	Misr 1	328	320	62	60	42.07	40.96
	Misr 2	324	318	64	63	41.23	39.47
	Sakha 94	300	306	54	52	47.65	46.26
	Sakha 95	324	315	55	51	48.69	47.68
	Sids 12	305	301	65	64	56.65	55.88
	Gemmeiza 11	305	309	65	65	56.35	55.96
	Gemmeiza 12	317	315	60	60	51.65	51.60
15thDec.	Giza 171	278	273	61	60	32.82	38.76
	Shandaweel 1	297	288	63	62	33.36	33.39
	Misr 1	291	290	59	57	33.40	32.93
	Misr 2	289	283	60	60	33.67	32.72
	Sakha 94	285	282	50	49	35.55	35.83
	Sakha 95	288	297	55	56	37.10	36.81
	Sids 12	283	290	61	61	46.41	45.05
	Gemmeiza 11	291	292	62	62	45.22	44.62
	Gemmeiza 12	289	289	60	60	39.81	42.02
LSD 5%		32.6	35.5	6.1	7.2	7.82	4.87

CONCLUSION

Sowing date has a critical role in rust management and grain yield of wheat. Minimum rust severity was recorded on early wheat sown on 1st November and for maximizing yield and its components wheat sown within November and prefer on Nov. 15 in recommended. However, Gemmeiza 11 and Misr 2 more tolerant to late sowing. On the other side, Sakha-95 was more rust resistance in both seasons.

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تأثير مواعيد الزراعة علي القدرة المحصولية و المقاومة للأصداء لبعض أصناف القمح

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يعتبر الصدأ الأصفر والبرتقالي والأسود من اخطر الأمراض التي تهدد إنتاج محصول القمح في العالم و مصر. تهدف هذه الدراسة إلي تقييم تأثير مواعيد الزراعة المختلفة علي أداء بعض أصناف قمح الخبز من خلال تقييم الشدة المرضية للأصداء وتقدير القدرة المحصولية خلال موسمي ٢٠١٥- ٢٠١٦ و ٢٠١٦-٢٠١٧. حيث تم تقييم تسعة أصناف من قمح الخبز وهي جيزة ١٧١- شندويل ١- مصر ١ -مصر ٢ – سخا ٩٤ -سخا ٩٥ – سدس ١٢ – جميزة ١١ – جميزة ١٢ تحت أربعة مواعيد زراعة مختلفة وهي الزراعة في الأول من نوفمبر- منتصف نوفمبر- أول ديسمبر- منتصف ديسمبر. ويمكن تلخيص النتائج فيما يلي : ١- أوضحت النتائج أن اقل أصابه مرضيه بالأصداء سجلت علي النباتات المنزرعة في الموعدين المبكرين بينما الزراعة المتأخرة تسببت في حدوث أعلي أصابه مرضيه. وهذا يشير إلي أن التأخير في زراعة محصول القمح بعد شهر نوفمبر يجعله عرضه للإصابة الشديدة بالأصداء وبالتالي يتسبب في خفض المحصول. ٢- أشارت النتائج أن الزراعة في منتصف نوفمبر سجلت أعلى عدد أيام حتى طرد السنابل، أطول النباتات، عدد السنابل في المتر المربع، المحصول البيولوجي، محصول الحبوب، عدد الحبوب في السنبلة، ومحصول التبن في الموسمين .بينما سجل ميعاد الزراعة المبكر أعلى عدد أيام حتى النضج وأثقل وزن للألف حبه . كان الصنف جميزة١١ أبكر الأصناف في تاريخ الطرد بينما كان الصنف مصر ٢ أخرها في كلا الموسمين. وكان الصنف سدس ١٢ وجميزة ١١ أبكر في عدد الأيام حتى النضج بينما الصنف شندويل ١ أخرها. كما كان أعلى محصول حبوب في الصنف سخا ٩٥والصنف مصر ٢ على التوالي كذلك كان الصنف سخا ٩٥ أعلي مقاومه للأصداء يليه كلا من الصنف شندويل١ وجيزة ١٧١ في كلا الموسمين. ٣- أظهرت النتائج أن هناك علاقة عكسية بين الشدة المرضية للأصداء و المحصول و أن هناك فروقا معنوية في كل الصفات المدروسة علي أصناف القمح المختلفة نتيجة تأثرها بمواعيد الزراعة المختلفة. توصي الدراسة بعدم التأخير في ميعاد الزراعة لأنه أدي إلى تقليل قيم هذه الصفات المدروسة في كلا الموسمين وزيادة الشدة المرضية للأصداء .