

**EFFECT OF IRRIGATION NUMBERS AND NITROGEN FERTILIZER ON THE GROWTH AND YIELD OF SOME NEW GRAIN SORGHUM HYBRIDS.**

**BY**

**O.M.S. Harb\*, G.H. Abd EL Hay\*, M.I. Bashir\*\* and Y.A.A. Yousef\*\***

\*Agronomy Department, Faculty of Agriculture, AL-Azhar University

\*\*Field Crops Res. Inst. A.R.C.

**ABSTRACT**

Two field experiments were carried out at Tamia Agric. Res. Farm, Fayoum Governorate during 2009 and 2010 seasons to investigate the effects of two main factors and their levels, irrigation numbers of 5, 6 or 7 irrigations and nitrogen fertilizer rates of 70, 85 and 100 kg N/fed on growth and yield as well as economic evaluation of the newly released three grain sorghum hybrids 301, 302 and 305 under calcareous soil conditions. The most important results get from the combined analyses of the two growing seasons showed that, 7 irrigations significantly increased days to 50% flowering, leaf area index (L.A.I.), grain weight/panicle, seed index (1000- grain weight), grain yield and forage yields of the three evaluated grain sorghum hybrids. Increasing nitrogen fertilizer rates from 70 to 85 up to 100 kg N/fed caused significant increments of days number to 50% flowering, L.A.I., grain weight/panicle, 1000 grain weight, grain and forage yield per fed. All best records of the studied traits were recorded for hybrid H. 305, except the fodder yield. The hybrid 305 realized the highest benefit (5476 L. E.) under 7 irrigations and 100 kg N/fed. Significant interaction effect between numbers of irrigation x nitrogen rate x grain sorghum hybrids was found. The greatest L.A.I., grain weight/panicle, grain yield/fed as 305 grain sorghum hybrid planted under the condition of 7 irrigations add fed by 100 kg N/fed.

**INTRODUCTION**

Grain sorghum (*sorghum bicolor* L. Moench) is the third most important crop in Egypt during summer season after maize and rice. It has ability to withstand hard conditions, so it is the first summer cereal crops in Fayoum Governorate that has special soil type effecting on the number of irrigation required. Several investigators studied the effects of irrigation number and nitrogen supply on grain sorghum. **Ahmed (1993) and Mohamed *et al* (1996)** stated that, linear relation between grain yield

and total water consumption for Rs 626 hybrid grain sorghum. **Latif et al (2000)** reported that irrigation every 21 days intervals significantly decreased leaf area index (L.A.I.), panicle length, panicle grain weight and grain yield compared with 7 and 15 days intervals.

The new grain sorghum hybrids having medium stature successfully grow with promising productivity in the newly reclaimed soils (sandy and calcareous) of Egypt especially at Fayoum region. Sorghum hybrids 301, 302 and 305 are dual purpose cultivars since they grown for grain and fodder production. So, these hybrids may be well respond to adequate supply of nitrogen especially under new reclaimed soils. **El- Bakry (1998)** reported that, some hybrids produced the highest grain yield at control treatment or at the two limited number of irrigations (3&4 irrigations) although number of days to 50% flowering did not significantly differed for all genotypes. **Mourad et al (2000)** showed that, area ratio, crop index and harvest index were considerably increased by increasing number of irrigations from 2 to 3, 4 and 5 irrigations. **Tomas (2003)** as well as, **Sepaskhah and Ghasemi. (2008)**, found that, increasing irrigation intervals from 5 to 10, 15 and 20 days significantly decreased leaf area index, number of grain/panicle, 1000 grain weight and grain weight/ha.

In Nubaria, Egypt, **Eweis et al. (1992)** found that growth characters and yield components of the cultivar Dorado were significantly increased parallel with increasing nitrogen fertilizer rates from 60 up to 100 Kg N/ fed. **Bashir et al. (1994)** indicated that, the average grain yield/feddan was significantly increased by 1.8 ardab per feddan when raising nitrogen rate from 80 to 100 Kg/feddan., **Saba et al (1990)** achieved maximum grain yield of short and tall sorghum varieties by using the highest nitrogen level 100 Kg N/fed, at Kom Ombo Research Station. **Hirpara et al (2002)** recorded that grain yield of sorghum was increased by

increasing the rate of 0 to 40, 80 or 120 kg N/ha application. They stated that in general, increasing nitrogen rates was associated with increasing panicle grain weight, 1000 grain weight, number of grains/panicle and grain yield per feddan.

Therefore, this study was designed to discover the influence of number of irrigations, nitrogen fertilizer rates and their interactions on growth and yield of some newly released sorghum hybrids.

### MATERIAL AND METHODS

Two field experiments were conducted in the clay loam soil at El-Fayoum governorate, Tamie Research Station during 2009 and 2010 summer seasons. Mechanical and chemical analysis of the experimental site recorded in Table (1). The research plane was conducted to study the effect of irrigation numbers i.e. 5, 6 and 7 and nitrogen fertilizer rates (70, 85 and 100 kg N/fed as Ammonium nitrate 33.5% N) on some growth, yield and its components of the new three grain sorghum hybrids of 301, 302 and 305.

The experimental design used in this study was split-split plot design in factorial arrangement with three replications. The main plots were assigned to irrigation number and the sub-plots were devoted to nitrogen fertilizer rates and the sub-sub plots assigned to grain sorghum hybrids.

**Table (1): Mechanical and chemical analysis of the experimental site at Tamia Res. Station farm soil.\***

Characteristics	2009 season	2010 season
Mechanical analysis		
Sandy %	38.00	37.80
Silt %	21.20	21.20
Clay %	40.80	41.00
Textural grade	Clay loom	Clay loom
Chemical analysis		
PH	8.12	8.11
E. C. (ds / m)	4.00	4.02
O. M. %	1.68	1.16
CaCO <sub>3</sub> %	5.18	5.16
Available N ppm	71	73
P ppm	18	19
K ppm	334	319

- Cited after Soil lab, Tamia Agricultural Research Station. Soil, water and
- Ecology Research Institute. Agric. Res. Center, Egypt.

The sub-sub plot area was 21.6 m<sup>2</sup> consisted of 6 ridges, 6 meters long, 60 cm. width and the distance between hills was 20 cm. All plots were uniformly fertilized with super phosphate 15.5% P<sub>2</sub>O<sub>5</sub> at the rate of 23 kg P<sub>2</sub>O<sub>5</sub>/fed which applied before sowing. Land preparation and all cultural treatment except studied treatments were followed as recommended for grain sorghum recommendation.

Sowing was done in 15<sup>th</sup> and 10<sup>th</sup> of June in 2009 and 2010 seasons respectively.

During the growing seasons the next growth characters were estimated at plant age of 65 days.

1- Number of days to 50% flowering.

2- Average leaf area index (L.A.I):-

Was calculated according to Kirby and Atkins (1968) formula from sample of 10 plants/plot.

At harvesting 10 plants were harvested from the middle row of each plot in the two seasons and the following data recorded:

1- Average grain weight/panicle (g).

2- 1000 grain weight (g).

At harvest grains and forage (kg) of each plot were recorded and then transformed in kg/fed for grain and forage yield ton/fed respectively.

3- Grain yield per fed. (Kg/fed).

4- Forage yield per fed. (Ton/fed).

#### **Economic evaluation:-**

Net income with Egyptian pounds per feddan for each treatment was estimated. Price of the grain yield/fed and forage yield per feddan as well as the cost of agriculture practices were considered according to the Ministry of Agriculture, and Land Reclamation, Economic Affairs Sector

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**Statistical analysis:-**

The data obtained from each season were subjected to the analysis of variance of split-split plot design as described by Snedecor and Cochran (1967). Varietal differences were detected by carrying out the combined analyses of the two trials on the two growing seasons, However treatment means were compared using the least significant difference (LSD) test at 0.05 levels, with the exception of economic evaluation.

**RESULTS AND DISCUSSION**

**1- Effect of irrigation numbers (I):-**

The results presented in Tables (2, 3 and 4) indicate that irrigation numbers had significant effect on growth, yield and it's components of grain sorghum plants.

Data recorded in the above mentioned tables indicate that, increasing numbers of irrigations from 5 to 6 and 7 led to increase number of days to 50% flowering by 3% and 5%, L.A.I. by 32% and 52%, grain weight/panicle by 7% and 12%, 1000 grain weight by 2% and 5%, grain yield per fed by 8% and 11% and forage yield by 11% and 15% respectively as compared with irrigate 5 times.

These results indicate that the five irrigations caused water defect during vegetative and pre-flowering stages of grain sorghum plants which led to decrease in water supply and nutrients, reflected on decrease in L.A.I., number of days to 50% flowering. Furthermore, continuing of water lack starting from developing flowers primordia till ovules fertilization may be led to the low appearance of florets primordia and decrease fertile flowers which in turn reduced grain weight/panicle, 1000 grain weight and grain and forage yield/fed. On the other hand the

sufficient water irrigations through 6 or 7 irrigations led to increase the above mentioned characters as shown before. Similar results were obtained by Ahmed (1993), Mohamed et al (1996), Latif et al (2000), Mourad et al (2000), Tomas (2003) Sepakhah and Ghasemi (2008).

**Table (2): Effect of irrigation numbers and nitrogen fertilizer rates on some growth characters of the three grain sorghum hybrids combined over analysis (2009 and 2010).**

No. of Irrigation (I)	Nitrogen rate kg/fed. (N)	50% flowering				L. A. I.			
		Hybrids (H)				Hybrids (H)			
		H (301)	H (302)	H (305)	Mean	H (301)	H (302)	H (305)	Mean
5	70	65.30	66.00	67.00	66.10	4.68	4.88	5.00	4.85
	85	67.40	68.28	68.65	68.11	5.27	5.83	5.77	5.62
	100	68.75	69.30	70.30	69.45	6.49	6.59	6.68	6.59
	Mean	67.15	67.86	68.65	67.48	5.48	5.76	5.82	5.69
6	70	66.40	67.40	68.55	67.45	6.52	6.15	6.71	6.46
	85	68.40	69.20	69.65	69.10	7.48	7.56	7.08	7.67
	100	70.65	71.00	71.90	71.18	8.39	8.43	8.57	8.47
	Mean	68.50	69.20	70.03	69.24	7.46	7.38	7.75	7.53
7	70	67.60	69.00	70.10	68.90	7.54	7.59	7.69	7.60
	85	69.85	70.85	71.55	70.75	8.69	8.74	8.85	8.76
	100	72.80	72.70	73.35	72.95	9.59	9.62	9.74	9.65
	Mean	70.08	70.85	71.66	70.87	8.61	8.65	8.76	8.67
G. M. H.		68.58	69.30	73.45	68.90	7.18	7.26	7.44	7.60
H x N	70	66.43	67.47	68.55	67.48	6.25	6.21	6.47	6.31
	85	68.57	69.44	69.95	69.32	7.14	7.38	7.54	7.35
	100	70.73	71.00	71.85	71.19	8.16	8.21	8.33	8.24
LSD at 5%	I		0.28				0.01		
	N		0.35				0.01		
	H		0.58				0.01		
	I x N		0.61				0.01		
	I x H		1.01				0.02		
	N x H		1.01				0.02		
	I x N x H		NS				0.04		

**Table (3): Effect of irrigation numbers and nitrogen fertilizer rates on some yield and its components of the three grain sorghum hybrids combined over analysis (2009 and 2010).**

No. of Irrigation (I)	Nitrogen rate kg/fed. (N)	Grain weight / panicle (gm)				1000 grain weight (gm)			
		Hybrids (H)				Hybrids (H)			
		H (301)	H (302)	H (305)	Mean	H (301)	H (302)	H (305)	Mean
5	70	42.55	41.58	49.50	44.56	28.67	27.98	30.28	28.98
	85	45.80	43.49	54.40	47.90	29.70	28.83	31.00	29.84
	100	49.15	47.52	58.15	51.61	31.50	30.80	32.94	31.75
	Mean	45.83	44.20	54.04	48.02	29.95	29.20	31.41	30.19
6	70	46.65	43.09	54.92	48.22	29.60	28.87	31.00	29.82
	85	50.55	48.44	57.60	52.20	30.36	29.60	31.81	30.59
	100	51.09	50.06	59.55	53.57	31.76	30.87	33.05	31.89
	Mean	49.43	47.20	57.36	51.33	30.57	29.78	31.95	30.77
7	70	47.26	46.55	57.30	50.37	30.46	29.64	31.75	30.62
	85	51.50	49.32	61.10	53.97	31.47	30.57	32.65	31.56
	100	54.35	52.31	61.32	55.99	32.55	31.83	34.00	32.79
	Mean	51.04	49.40	59.91	53.45	31.49	30.68	32.80	31.66
G. M. H.		48.77	46.93	57.10	50.37	30.67	29.88	32.05	30.62
	70	45.49	43.74	53.93	47.72	29.58	28.83	31.01	29.81
	85	49.28	47.09	57.70	51.36	30.51	29.67	31.82	30.67
H x N	100	51.53	49.96	59.67	53.72	31.94	31.17	33.33	32.14
	LSD at 5%	I		0.03				0.23	
	N			0.03				0.25	
	H			0.05				0.52	
	I x N			0.05				0.44	
	I x H			0.09				0.90	
	N x H			0.09				0.90	
	I x N x H			0.15				NS	

**2- Effect of nitrogen fertilizer rates:-**

Results recorded in Table (2, 3 and 4) show clearly that, number of days to 50% flowering, L.A.I., grain weight/panicle, 1000 grain weight, grain and forage yields/fed were increased gradually and significantly by increasing nitrogen rate from 70 kg N/fed to 85 or 100 kg N/fed led to increase L.A.I. by 3% and 6%, grain yield/fed by 6% and 9% forage yield/fed by 5% and 7% respectively as compared by 70 kg N/fed. This results may be due to sufficient nitrogen led to delay grain sorghum

plants maturity and increased vegetative stage reflected on increase leaf area index (L.A.I.) and then improved the net assimilation rate. These results reflected on increase growth and yield and its component. The some results were in agreement with recorded by Eweis et al (1992), Bashir et al (1994), Saba et al (1990) and Hirpara et al (2002).

**Table (4): Effect of irrigation numbers and nitrogen fertilizer rates on some yield and its components and combined over analysis (2009 and 2010) of the three grain sorghum hybrids.**

No. of Irrigation (I)	Nitrogen rate kg/fed. (N)	Grain yield (kg/fed)				Forage yield (kg/fed)			
		Hybrids (H)				Hybrids (H)			
		H (301)	H (302)	H (305)	Mean	H (301)	H (302)	H (305)	Mean
5	70	2274.50	2233.50	2607.50	2371.83	13.05	12.90	12.00	12.65
	85	2402.00	2361.00	2735.00	2499.33	13.65	13.20	12.40	13.08
	100	2522.00	2481.50	2855.00	2619.50	14.05	13.65	12.85	13.52
	Mean	2399.83	2358.66	2732.49	2497.11	13.60	13.25	12.40	13.10
6	70	2474.00	2433.50	2807.00	2571.50	14.15	13.85	13.20	13.73
	85	2625.00	2584.00	2958.00	2722.33	15.05	15.00	13.85	14.63
	100	2691.00	2650.00	3024.33	2788.44	15.40	15.30	14.35	15.02
	Mean	2596.66	2555.66	2929.99	2694.16	14.88	14.70	13.75	14.48
7	70	2576.50	2536.00	2909.50	2674.00	14.95	14.90	13.95	14.60
	85	2705.00	2664.50	3038.50	2802.66	15.50	15.40	14.45	15.12
	100	2756.50	2716.50	3090.00	2854.33	15.95	15.55	14.80	15.43
	Mean	2679.33	2639.00	3012.66	2777.00	15.45	15.30	14.41	15.05
G. M. H.		2558.61	2517.77	2891.71	2673.99	14.64	14.41	13.52	14.60
H x N	70	2441.67	2401.00	2774.67	2539.11	14.05	13.88	13.05	13.66
	85	2577.33	2536.50	2910.50	2674.77	14.73	14.53	13.57	14.28
	100	2656.50	2616.00	2989.77	2754.09	15.13	14.83	14.00	14.66
LSD at 5%	I			0.01				0.09	
	N			0.01				0.07	
	H			0.02				0.22	
	I x N			0.01				0.13	
	I x H			0.04				0.38	
	N x H			0.04				0.38	
	I x N x H			0.07				0.66	



### **3- Variance between hybrids:-**

Results presented in Tables (2, 3 and 4) revealed that, grain sorghum hybrids tested differed significantly in No. of days to 50% flowering, L.A.E., grain weight/panicle, 1000 grain weight, grain and forage yield/fed. Grain sorghum hybrid of 305 ranked first for all above mentioned characters with the exception of forage yield/fed that grain sorghum hybrid of 301 gave the greatest value 14.95 ton/fed. These results may be due to the genetic variations between grain sorghum hybrids tested as reported by Eweis et al (1992), Bashir et al 1994, Yousef et al (1996) and latif et al (1999).

### **4- Interaction effects:-**

#### **A- The first order Interaction effect:-**

Number of irrigation x N. rate interaction had significant effect on all above mentioned studied characters. Irrigation grain sorghum plants 7 times and fertilized by, 100 kg N/fed resulted the greatest values for days to 50% flowering (72.95), L.A.E. (9.65), grain weight/panicle (55.99 gm), 1000 grain weight (34.00 gm) grain yield/fed (3090 kg/fed) and forage yield per fed.(15.43 ton/fed).

Results recorded in Tables (2, 3 and 4) show that, No. of irrigation x grain sorghum hybrids interaction had significant effect on all tested characters except forage yield/fed. The Grain sorghum hybrid of 305 showed its superior to utilize the greatest amount of water irrigation (7times) reflected on greatest values for No. of day to 50% flowering, (71.66 days), L.A.E. (8.76), grain weight/panicle (59.91 gm), 1000 grain weight (32.80 gm) and grain yield/fed (3012.66 kg). On the other hand grain sorghum hybrid 301 which received 100 kg N/fed gave the greatest forage yield/fed (15.45 ton/fed).

As for the nitrogen rates x grain sorghum hybrids interaction effect, results cleared that, grain sorghum hybrids of 305 plants fertilized by 100 kg N/fed. gave the maximum values for all characters studied except forage yield/fed which the greatest yield was resulted by growing H. 301 under the treatment of 100 kg N/fed (15.13 ton/fed.)

**B-The second order interaction affect:-**

Regarding to the interaction between the three factors under study, results showe that it had significant effect on L.A.E., grain weight per panicle and grain and forage yield/fed. 305 grain sorghum hybrid planted under the condition of 7 irrigations and fertilizer by 100 kg N/fed. gave the greatest values for L.A.I. (9.74), grain weight/panicle, grain yield/fed (3090 kg/fed). while 301 grain sorghum hybrid grown under the same condition gave the highest forage yield/fed. (15.95 ton/fed).

**C- Economic evaluation achieved and revealed the realized benefit with (L.E.) as the following: -**

The economic return evaluation for of irrigation No. (I). Nitrogen rates (N), each hybrid and the different levels of interactions between the above mentioned treatments, were recorded in Table (5). It is clearly that, the net income grain sorghum plants was increased by increasing irrigation numbers of grain sorghum plants. Results in Table (5), revealed that, net income was increased by 14.00% and 19.0% by adding 6 or 7 irrigations compared with 5 irrigations, but it wealthy to mention that the net income was increased by 5.0% only, it equal 213 L.E by irrigation grain sorghum plant 7 times as compared with those irrigated 6 times

**Table (5): Effect of irrigations number, nitrogen fertilizer rates, sorghum hybrids and their interaction on the net income (L.E.)**

No. of Irrigations (I)	Nitrogen Rates (N)	Hybrids									Mean
		H-301			H-302			H-305			
		Price of yield	cost	Net income	Price of yield	cost	Net income	Price of yield	cost	Net income	
5	70	6426	2611	3815	6321	2611	3710	6923	2611	4312	3945
	85	6766	2674	4092	6616	2674	3942	7233	2674	4559	4197
	100	7060	2739	4321	6923	2739	4181	7535	2739	4796	4432
Mean		6750	2674	4076	6620	2674	3944	7230	2674	4555	4191
6	70	6982	2648	4334	6857	2648	4209	7494	2648	4846	4463
	85	7414	2711	4703	7326	2711	4615	7888	2711	5177	4831
	100	7595	2776	4819	7500	2776	4724	8092	2776	5316	4953
Mean		7330	2711	4618	7227	2711	4516	7824	2711	5113	4749
7	70	7302	2685	4617	7215	2685	4530	7807	2685	5122	4756
	85	7638	2748	4890	7543	2748	4785	8135	2748	5387	5024
	100	7807	2813	4994	7667	2813	4854	8289	2813	5476	5108
Mean		7582	2748	4833	7475	2748	4726	8077	2748	5328	4962
Mean N	70	6903	2648	4255	6797	2648	4149	7408	2648	4760	4388
	85	7272	2711	4561	7161	2711	4447	7752	2711	5041	4683
	100	7487	2776	4711	7363	2776	4586	7972	2776	5196	4831
Mean H.		7220	2711	4509	7107	2711	4395	7710	2711	4998	4635

Results in Table (5) showed that, supply grain sorghum plants by 100 kg N/fed led to increase net income per fed. by 10% it equal 443 L.E. as compared with adding 70 kg N/fed, on the other hand adding N. at the rate of 85 kg/fed gave 3% reduction in net income it equal 148 L.E as compared with adding 100 kg.

As for grain sorghum hybrids, results cleared that H.305 ranked first in net income (4635 L.E.) followed by H.301 (4509 L.E.).

As for the interaction effect results in Table (5) revealed that, irrigation grain sorghum plants 7 times and fed by 85 or 100 kg N/fed gave the greatest net income (5024 or 5108 L.E.) respectively.

Results also showed that, watering grain sorghum hybrid of H.305 7 times gave the greatest net income 5328 L.E.

As for N x H interaction, results showed that, the greatest net income was resulted by planting grain sorghum hybrid of 305 under the condition of adding 85 or 100 kg N and the differences not great.

As for the effect of the second order interaction (I x N x H), results in Table (5) cleared that planting grain sorghum hybrid of 305 under the condition of irrigation 7 times and get 85 or 100 kg N/fed gave the maximum net income of 5387 and 5476 L.E.

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تأثير عدد الريات ومعدلات التسميد الآزوتى على نمو ومحصول بعض الهجن من النزه الرفيعة.

#### الملخص العربي

اسامه محمد سعد الدين حرب \* جمال حسن عبد الحى \* محمد ابراهيم بشير \*\* يوسف عجمي  
علي يوسف \*\*

\* قسم المحاصيل – كلية الزراعة – جامعة الأزهر  
\*\* معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعيه

أقيمت تجربتان حقليتان بمزرعة محطة البحوث الزراعيه بطاميه محافظة الفيوم خلال موسمي ٢٠٠٩ و ٢٠١٠ لدراسة عدد الريات (٥ و ٦ و ٧ ريات) ومعدلات السماد الآزوتى (٧٠ و ٨٥ و ١٠٠ كجم نتروجين للفدان) على نمو ومحصول هجن النزه الرفيعة (٣٠١ و ٣٠٢ و ٣٠٥) وقد أوضحت النتائج مايلي:-

١- أدت زيادة عدد الريات لـ ٧ ريات إلى زياده معنويه فى عدد الأيام اللازمه لتزهير ٥٠% من النباتات و دليل مساحة الأوراق كما أدى إلى زياده معنويه فى وزن حبوب القنديل ووزن الألف حبه ومحصول الحبوب بالكجم ومحصول العلف بالطن للفدان.

٢- أدى زيادة معدلات السماد الآزوتى (١٠٠ كجم نتروجين للفدان) إلى زياده معنويه فى عدد الأيام اللازمه لتزهير ٥٠% من النباتات و دليل مساحة الأوراق كما أدى إلى زياده معنويه فى وزن حبوب القنديل ووزن الألف حبه ومحصول الحبوب بالكجم ومحصول العلف بالطن للفدان.

٣- أدى زراعة هجين ٣٠٥ إلى زياده معنويه فى عدد الأيام اللازمه لتزهير ٥٠% من النباتات و دليل مساحة الأوراق كما أدى إلى زياده معنويه فى وزن حبوب القنديل ووزن الألف حبه ومحصول الحبوب بالكجم للفدان بينما أدى زراعة هجين ٣٠١ إلى زياده معنويه فى محصول العلف بالطن للفدان.

٤- أدى زراعة هجين ٣٠٥ مع استخدام ٧ ريات و ١٠٠ كجم نتروجين للفدان إلى زياده معنويه فى دليل مساحة الأوراق كما أدى إلى زياده معنويه فى وزن حبوب القنديل ووزن الألف حبه ومحصول الحبوب بالكجم للفدان بينما لم تكن هناك فروق معنويه فى عدد الأيام اللازمه لتزهير ٥٠% من النباتات.

٥- أدى زراعة هجين ٣٠٥ مع استخدام ٧ ريات و التسميد بمعدل ١٠٠ كجم نتروجين للفدان إلى تحقيق أعلى عائد اقتصادى وقدره (٥٤٧٦ جنيه مصرى للفدان).









