EFFECT OF SEEDING RATE AND NITROGEN LEVEL ON PHENOLOGY, GROWTH AND YIELD OF, SAKHA 101 AND SAKHA 102 RICE CULTIVARS UNDER BROADCAST- SEEDED RICE

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Abstract

Two field experiments were conducted at the experimental farm of Rice Research and Training Center, Sakha, Kafr El-Sheikh, Egypt during 2002 and 2003 seasons to study the effect of seeding rates Viz, 31, 40, 50 and 60 kg / fed. (71, 95, 119, 143 Kg/ha.) and nitrogen levels Viz, .0, 23, 46, 69 and 92 kg/fed.(0, 55, 110, 164 and 219 Kg N/ha.) on phenology, growth and yield of Sakha 101 and Sakha 102 rice cultivars. The days from sowing up to maximum tillering stage, panicle initiation and heading were estimated. In addition, chlorophyll content, leaf area index, yield and yield components were determined. The main results could be summarized as follows: nitrogen levels and seed rates significantly affected all abovementioned traits. The highest values of growth characters, yield components and grain yield were obtained with the highest nitrogen level (219 Kg N/ha.) Increasing nitrogen levels delayed the plant phonology (i.e. the highest seed rate and nitrogen level prolonged the plant phonology). The optimum seed rate was 114 Kg seed /ha. Sakha 101 rice cultivars performed better than Sakha 102. Besides, Sakha 101 had the longest periods from sowing up to maximum tillering stage (MT), panicle initiation (PI) and heading date (HD).

INTRODUCTION

The yield of lowland rice is usually limited by the supply of soil nitrogen. Application of nitrogen fertilizer to rice increases the yield markedly but is costly because of the low N use efficiency of fertilizer nitrogen in flooded soil .It has been reported by several workers that N fertilizer recovery is usually in the range of 30 to 40% using conventional application methods, and even with the best agronomic practices seldom exceeds 60 to 65% (Hamissa *et al.* 1986 and Singh *et al.* 1991).

Rice growth characteristics namely plant height, tillers /m^2, leaf area index and dry matter content, grain yield and its components (i.e., number of panicles/m^2, number of grains/panicle, filled grain % and 1000 grain weight) were significantly increased when rice was fertilized with 60 kg/N fed. (144kg N/ha) as double- split application (2/3 or ½ of the dose was incorporated in dry soil: immediately before planting and the rest at panicle initiation (Mahrous *et al*, 1986, Hamissa *et al.*, 1986 and Abd EL-Wahab *et al.* 1998).

Ebaid and Ghanem (2001), Bassal and Zahran (2002) reported that nitrogen levels up to 60 kg N/fed significantly increased growth parameters, yield attributes and straw and grain yield.

Kim *et al.* (1996) found that seed rate of 80 kg/ha gave higher values of growth parameter components, yield and grain quality such as milling % , hulling % than those obtained by 50 kg seed /ha, Hari *et al.*, (1997), Prasad *et al.*, (1999) and Vromant *et al.,* (2001) came to the same results. Zayed (2002) and El-Khoby (2004) found significant variations among rice cultivars in growth, yield attributes and grain yield.

A research conducted by RRTC (2000) indicated that the optimum seeding rate for higher grain yield ranged between 144 kg /ha (60kg/fed.) and 190 kg /ha (80 kg/fed.) the difference between yields obtained from the two seeding rates was not statistically significant, hence, 144 kg seed/ha were recommended.

The current work is an attempt to evaluate growth characters, yield components and grain yield of two early maturing Egyptian rice cultivars under different N-levels and seeding rates.

MATERIALS AND METHODS

Two field experiments were conducted at the experimental farm of Sakha Agricultural Research Station, Kafr El-Sheikh during 2003 and 2004 rice growing seasons. The study aimed to investigate the impact of five nitrogen levels (0, 23, 46, 69 and 92 kg N/fed) and four seed rates, 30, 40, 50 and 60 kg / fed on growth and yield of two broadcasted rice cultivars viz Sakha 101 and Sakha 102. The experimental design was a split-split plot with four replications. The main plots were occupied by nitrogen levels, while seed rates were distributed into the sub-plots. The rice cultivars were assigned to the sub-sub plots.

The sub-sub plot area was 20 m^2 (4x5m^2). The cultural practices was applied according to the package of recommendations.

The studied parameters were estimated at three growth stages viz, vegetative growth stage, heading stage heading stage and at harvesting time. The following characters were studied:

A- Maximum tillering period(MT), panicle initiation (PI) and heading stage (HD)in days.

B- Number of tillers, leaf area index (LAI), chlorophyll content. Besides, light penetration (by lax-meter) was estimated at heading stage.

C- Panicle length, number of branches/ panicle, panicle number/m^2, number of filled grains / panicle, 1000-grain weight and grain yield were estimated at harvest time.

Data were subjected to statistical analysis of variance for each season and pooled over the two seasons. The differences among means of the studied traits were calculated according to the least significant difference test (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

1- Growth stage development :

Data listed in Table 1 revealed that increasing nitrogen level had an effective impact on delaying growth stages i.e. maximum tillering stage, panicle initiation (PI) and heading stages (HD). It was observed that increasing nitrogen level up 92 Kg N/fed prolonged the period from sowing to MT, PI and HD. The highest nitrogen level of 92 kg N/fed delayed the before mentioned stages than control by 5, 7 & 4 days for MT, PI & HD, respectively. Hence, panicle initiation was much affected than other two stages by increasing nitrogen level. Both of the nitrogen levels of 69 and 92 N/fed gave the longest period of panicle initiation and heading date. The increase in nitrogen might have encouraged and stimulated the vegetative growth stage against the reproductive stage and thereby it delayed the rice plant phonology. The obtained results completely agreed with those reported by Abd El-Wahab (1998), and El-Kady and Abd El-Wahab (1999).

In addition, the data documented in Table 1 showed that the seed rate had a pronounced effect on plant phonology whereas, any rate increment prolonged the period of MT, PI and HD. The longest period from sowing up to MT , PI and HD was obtained by the highest seed rate (60 kg seed /fed), while the shortest period was obtained by the seed rate of 30 kg /fed. The delayed periods of MT, PI & HD were exerted by the highest seed rate (60 kg seed /fed)compared to those of lowest rate (30kg seed/fed) ,and the differences amounted to 5, 3 & 2 days respectively. It seem that under high density, the competition among rice plants is so high and hence the cell division and other plant development processes slow down, leading to delay in plant phonology. Those findings are in a good agreement with those reported by El-Khoby (2004).

As for cultivar performance, it was clear that the two tested rice cultivars significantly varied regarding the progress of growth development stage. The rice cultivar Sakha 101 had the longest period from sowing to MT, PI & HD, while Sakha 102 had the shortest periods. The variation between the two tested cultivars could be

mainly due to the difference in genetic makeup. The obtained data were in harmony with those reported by Abd El-Wahab *et al.*, (1998), and Zayed (2002).

Table 1. Maximum tillering, panicle initiation and heading date of two rice cultivars, Sakha 101 and Sakha 102 as affected by nitrogen levels and seeding rates

Treatments	Maximum tiller	Panicle initiation(days)	Heading date(days)
Nitrogen level:			
Control	46	48	89
23N/fad.	49	50	90
46N/fad.	49	52	91
69N/fad.	50	52	93
92N/fad.	51	55	93
L.S.D. at 5%	0.4	0.47	0.41
Seeding rate:			
30 kg/fed.	49	51	90
40 kg/fed.	50	51	91
50 kg/fed.	52	52	92
60 kg/fed.	54	54	92
L. S. D. at 5%	0.37	0.42	0.37
Rice cultivar:			
Sakha 101	53	56	96
Sakha 102	44	47	86
F test	**	**	**

2- **Growth Characters** :

The data collected on number of tillers/m^2 , leaf area index (LAI), chlorophyll content and light penetration of the two tested rice cultivars as affected by nitrogen levels and seeding rates are presented in Table 2.

The various nitrogen levels had a marked positive effect on the studied traits. It was observed that increasing nitrogen levels up to 92 Kg N/fed significantly raised number of tillers/m^2, LAI and chlorophyll content, while it diminished the light penetration value.

The highest values of the studied traits were produced using the highest nitrogen level of 92 kg N/fed. Except for light penetration which was at its maximum under0 kg N/fed. This is normal because LAI was low and allows for more light to penetrate. The lowest values of the growth parameters were obtained by zero nitrogen level. It is well known that the nitrogen had a positive impact on plant growth and plant metabolism and photosynthesis process. The data came to similar view with those obtained by Abd El-Wahab (1998), El-Kady and Abd El-Wahab (1999), Ebid and Ghanem (2001), Bassal and Zahran (2002).

Table 2. Number of tillers, LAI, chlorophyll content and light penetration as affected by nitrogen levels, seeding rate and some rice cultivars.

Treatments	Number of tiller	Leaf area index	Chlorophyll content(ppm)	Light penetration
Nitrogen levels				
Control	329	3.64	34.63	3875
23N/fad.	384	5.43	36.5	3358
46N/fad.	411	5.70	37.63	2958
69N/fad.	439	5.93	40.38	2582
92N/fad.	459	6.57	41.48	2182
L.S.D. at 5%	10.71	0.32	1.91	182
Seeding rate				
30 kg/fed.	382	4.9	37.1	3320
40 kg/fed.	398	5.23	37.8	3087
50 kg/fed.	414	5.73	38.09	2690
60 kg/fed.	424	5.96	39.5	2868
L .S. D. at 5%	9.58	0.30	1.71	163
Rice cultivar				
Sakha 101	425	5.97	38.92	2531
Sakha 102	385	4.94	37.33	3451
F. test	**	**	**	**

As for seeding rate effect, data in Table (2) showed that the various seeding rates had a positive and significant effect on the studied growth parameters of rice plants under study.

Increasing seeding rates, markedly enhanced all growth parameters and reduced light penetration, due to intense canopy. The highest values of growth parameters were recorded when the high seed rate of 60 kg seed/fed was used while the lowest values were at the lowest seed rate (30 kg seed / fed). By contrast, the light penetration showed the opposite trend. In a conclusion, the optimum seed rate differently gave proper population leading to considerable growth, and this cause more light interception. These results are in agreement with those reported by Kim *et al* (1996) and El-Khoby (2004).

With respect to rice cultivar performance, a great variation was detected between the two tested rice cultivars in all studied growth parameters. Generally-speaking, Sakha 101 surpassed Sakha 102 in all studied traits The variation in growth parameters has been recorded by Abd El-Wahab (1998) and Zayed (2002) as well as El-Khoby (2004).

3- Panicle length, number of branches / panicle and number of panicles/m^2.

As shown in Table 3, the data revealed that nitrogen levels had a positive effect on the abovementioned traits. Furthermore, increasing nitrogen levels up to 92 Kg N/fed significantly increased the panicle length, number of branches/panicle and number of panicles/m^2, the lowest values of the above mentioned traits were produced when no nitrogen was applied. Meanwhile, the highest values were recorded when the highest nitrogen level (92 kg n /fed) was added to both rice

cultivars. It seems that increasing nitrogen level enhanced each of cell elongation and cell division, and subsequently raised trait values. The obtained data are in a complete conformity with those reported by Leilah and El-Kalla (1989), Abd El-Wahab (1998), Ebiad and Ghanem (2001) and Bassal and Zahran (2002).

With respect to the effect of seed rate on panicle length, number of branches/panicle and number of panicles/m^2, the data listed in Table (3) showed that a significant effect was induced by the seed rate on the formerly characters. Increasing seed rate up to 40 kg /fed significantly raised all those traits. Increasing seed rate beyond the seed rate of 50 kg /fed. started to reduce the abovementioned traits.

The low seed rate of 30 kg seed and high seed rate 60 kg gave almost the same panicle length. It was observed that under high seed rate of 60 kg panicle length, number of branches/panicle and panicle number were limited due to the high density and high competition. The seed rates of 30 and 40 kg /fed were at a par in panicle number/m2 as well as the seed rates of 40,50 and 60. The shortest panicle was produced by low seed rate of 30 kg/fed, while the longest ones were by 50 kg seed /fed.The highest values of branches number and panicles number were produced by the seed rate of 50 kg /fed. The lowest number of branches were produced by the highest seed rate of 30 kg /fed. The obtained data are in agreement with those reported by Kim et al., (1996), Hari *et al.*, (1997), Prassad *et al.*, (1999), Vromant *et al.*, (2001) and El-Khoby (2004).

Table 3. panicle length/cm, number of branches/panicle and number of panicles/m^2 of Sakha 101 and Sakha 102 as affected by nitrogen levels and seeding rates

Treatments	Panicle length/cm	Number of branches/panic	Number of panicles/m^2
Nitrogen levels			
Control	20.72	10.00	326
23N/fad.	22.44	12.59	380
46N/fad.	23.43	13.88	403
69N/fad.	24.31	15.19	432
92N/fad.	25.00	16.56	452
L. S. D. at 5%	0.56	0.30	8.1
Seeding rate			
30 kg/fed.	22.58	13.38	31
40 kg/fed.	23.34	14.18	33
50 kg/fed.	24.12	14.88	46
60 kg/fed.	22.68	12.15	44
L. S. D. at 5%	0.5	0.23	7.6
Rice cultivar			
Sakha 101	23.89	15.56	417
Sakha 102	22.47	11.73	379
F test	**	**	**

Concerning rice cultivar performance, the two tested rice cultivars significantly varied in their panicle length, branch number/panicle and panicle number/m^2. As shown in Table 3, Sakha 101 had the superiority over Sakha 102 regarding those traits. Similar variations have been reported by Abd El-Wahab (1998), Zayed (2002) and El-Khoby (2004).

The interaction between nitrogen level and rice cultivars had a significant effect on branch number/panicle (Fig.1). The best combination was Sakha 101 and the highest nitrogen level of 92 Kg N/fed.

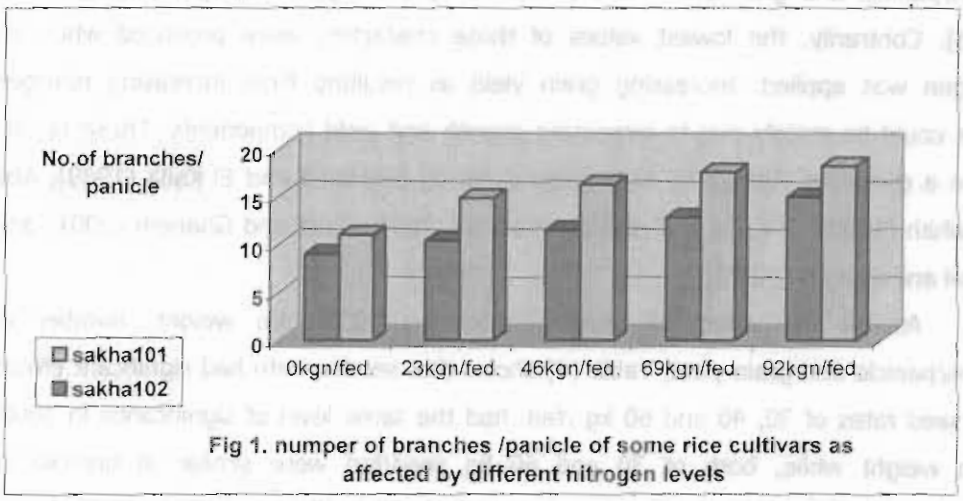

Fig 1. numper of branches /panicle of some rice cultivars as affected by different nitrogen levels

The interaction between seeding rate and rice cultivars had marked effect on branches number/panicle (Fig. 2). The highest branches number /panicle was produced by Skaha 101 when it was seeded by 50 kg seed/fed. and the lowest number of branches was produced by Sakha 102 with the highest seed rate of 60 kg seed /fed.

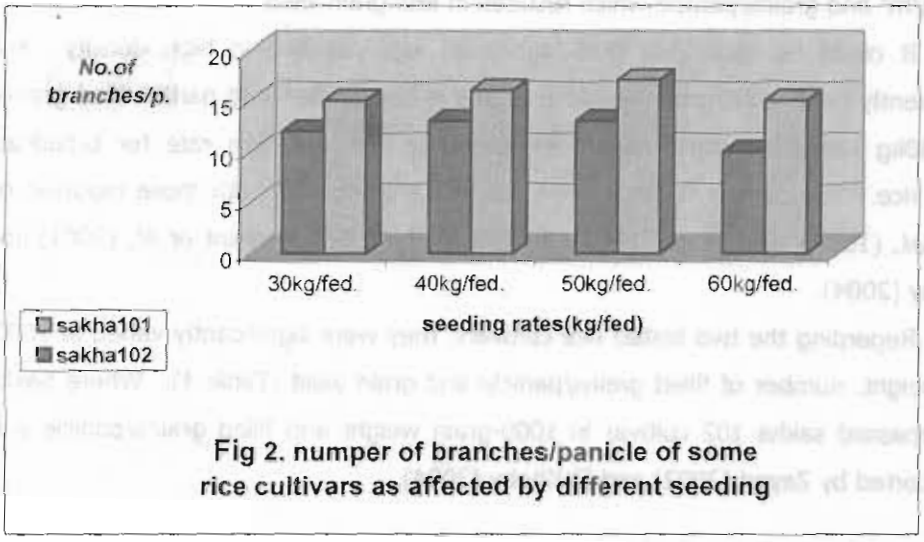

Fig 2. numper of branches/panicle of some rice cultivars as affected by different seeding

4- 1000-grain weight, number of grains/panicle and grain yield:

Regarding the effect of nitrogen level on the three abovementioned traits, data in Table 4 showed that there was a positive effect on each of them .

As it was recorded before, increasing nitrogen levels up to 92kgN/fed. significantly enhanced 1000-grain weight, number of grains / panicle and grain yield up to 92kg N/ha. In most of nitrogen levels the increment in 1000-grain weight did not show significant differences. The highest values of 1000-grain weight, number of grains/panicle and grain yield were produced by the highest nitrogen level (92 kg N/fed). Contrarily, the lowest values of those characters were produced when no nitrogen was applied. Increasing grain yield as resulting from increasing nitrogen levels could be mainly due to increasing growth and yield components. These results are in a complete agreement with those reported by Leilah and El-Kalla (1989), Abd El-Wahab (1998), El-Kady and Abd El- Wahab (1999), Ebiad and Ghanem (2001) and Bassal and Zahran (2002).

As for the effect of seeding rates on 1000-grain weight, number of grains/panicle and grain yield, Table (4) shows that seeding rate had significant effect. The seed rates of 30, 40 and 60 kg /fed. had the same level of significance in 1000-grain weight while, both of 30 and 60 kg seed/fed were similar in number of grains/panicle. Furthermore, the seed rates of 40, 50 & 60 kg seed/fed were at a par in grain yield. The highest records of 1000-grain, number of grains/panicle and grain yield were obtained when the seed rate of 50kg/fed.was used.

The lowest value of grain number / panicle and grain yield were produced by the seed rate of 30 kg /fed. As seen before, the low seed rate of 30 kg seed gave less panicles/m^2 and grains/panicle which resulted in less grain yield.

It could be concluded that high seed rate resulted in high density and consequently hegh 1000-grain weight due to the competition and partial filled grains. Thus, 40kg seeds/fed could be recommended as the optimum rate for broadcast seeded rice. The current findings are in complete conformity with those reported by Kim *et al.*, (1996), Hari *et al.*, (1997), Prasad *et al.*, (1999), varmint *et al.*, (2001) and El-Khoby (2004).

Regarding the two tested rice cultivars, they were significantly varied in 1000-grain weight, number of filled grains/panicle and grain yield (Table 4). Where Sakha 101 surpassed sakha 102 cultivar in 1000-grain weight and filled grains/panicle was also reported by Zayed (2002) and El-Khoby (2004).

Table 4. Number of grains/panicle, 1000-grain weight and grain yield/(t/ha) of rice cultivar Sakha 101 and sakha102 as affected by nitrogen levels and seeding rates

Treatments	1000-grain weight (g)	Number of grain/panicle	Grain yield/t/ha
nitrogen levels			
Control	28.36	97.59	6.67
23N/fad.	29.63	109	9.26
46N/fad.	30.00	111	9.57
69N/fad.	30.34	114	9.86
92N/fad.	30.77	117	10.54
L. S. D. at 5%	0.43	2.16	0.6
Seeding rate			
30kg/fed.	29.53	107	8.94
40kg/fed.	29.72	111	9.13
50kglfed.	30.4	113	9.55
60kg/fed.	29.63	108	9.33
L. S. D. at 5%	0.30	1.93	0.58
Rice cultivar			
Sakha 104	29.74	113	10.14
Sakha 101	29.9	107	8.33
F test	**	**	**

The interaction between nitrogen levels and rice cultivars had a significant effect on 1000-grain weight (Fig 3). The best combination was Sakha 101 with seed rate of 50 kg seed /fed, while the worse combination was Sakha 102 with low seed rate of 30 kg seed /fed. The obtained data are in agreement with those reported by Abd El-Wahab (1998).

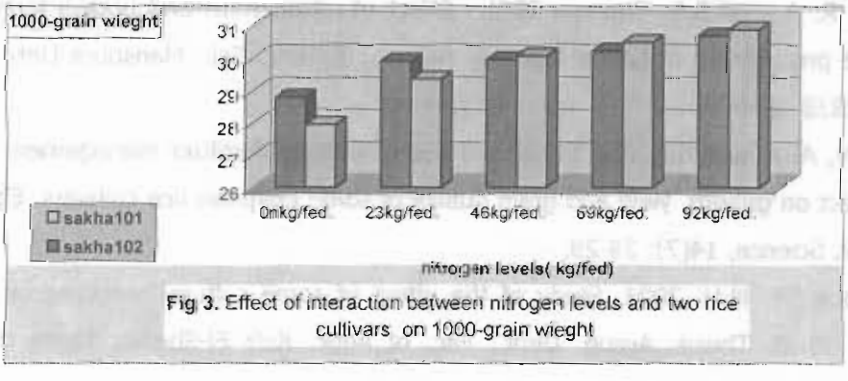

Fig 3. Effect of interaction between nitrogen levels and two rice cultivars on 1000-grain wieght

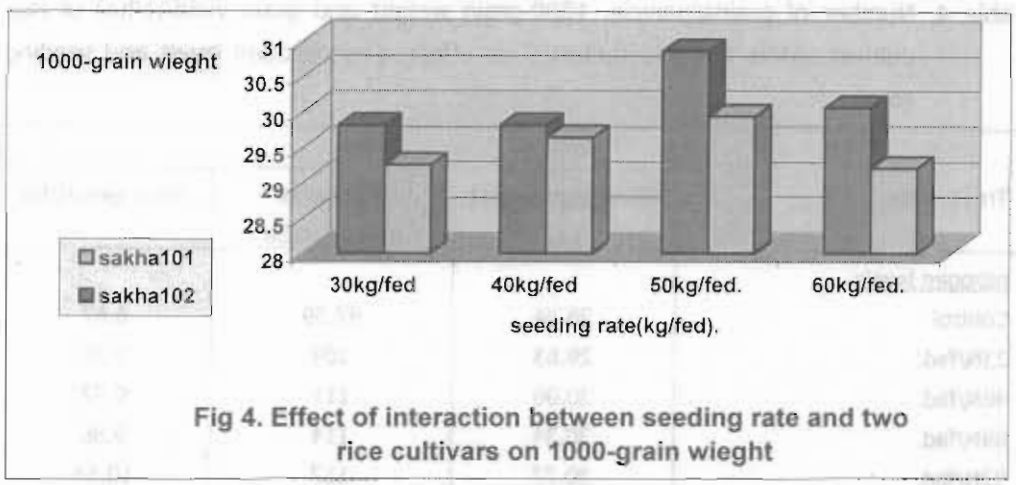

Fig 4. Effect of interaction between seeding rate and two rice cultivars on 1000-grain wieght

The interaction between seeding rates and the two rice cultivars are presented in Fig (4). The data revealed that 50 kg seeds / fed with Sakha 101 cultivar gave the highest number of branches / panicle, while the lowest number of branches / panicle was seen with 60kg seeds / fed with Sakha 102 cultivar.

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تأثير معدل التقاوي ومستوى النيتروجين على تطور مراحل نمو وإنتاجية صنفى الأرز سخا ١٠١ ، ١٠٢ تحت طريقة الزراعة البدار

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أقيمت تجربتان حقليتان بمزرعة مركز البحوث والتدريب فى الأرز – سخا – كفر الشيخ خلال موسمى ٢٠٠٣ ، ٢٠٠٤ وذلك لدراسة تأثير معدلات التقاوى وهى ٧٠ ، ٩٥ ، ١١٩، ١٤٣ كجم / هكتار (٣١، ٤٠،٥٠و٦٠كجم فدان) ومعدلات النيتروجين وهى صفر ، ٥٥، ١١٠، ١٦٤ ، ٢١٩ كجم نيتروجين / هكتار(٠،٢٣، ٤٦،٦٩و٩٢) على تطور ونمو محصول صنفي الأرز سخا ١٠١، سخا ١٠٢ المنزرعين بطريقة الزراعة البدا ر . وتم تقدير الفترة الزراعية وحتى أقصى تفريع وبداية تكوين السنبلة وكذلك ميعاد الطرد ومحتوى الكلوروفيل ودليل مساحة الورقة والمحصول ومكوناته. وكانت أهم النتائج كالآتى : أثر كل من معدلات التقاوى والنيتروجين على جميع الصفات المدروسة. سجلت أعلى قيم لصفات النمو والمحصول ومكوناته عندما أُضيف ٢١٩ كجم نيتروجين للهكتار. زيادة كل من معدلات التقاوى والنيتروجين أدت إلى إطالة المراحل المختلفة من حياة النبات. وكان أفضل معدل تقاوى فى حالة المحصول ومكوناته والنمو الخضرى هو ١٤٣ كجم تقاوى / هكتار(٦٠كجم/فدان) ولقد تفوق الصنف سخا ١٠١ فى كل من صفات النمو والمحصول ومكوناته على الصنف سخا ١٠٢ وعلاوة على أن الصنف سخا ١٠١ كانت فترة نموه أطول.