Effect of Planting Dates and Compouned Fertilizers on Growth, Yield and Quality of Hassawi Onion Under Al-Hassa Oasis Conditions

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Abstract:

A field experiment was carried out during 1999-2000and 2000-2001, to study the effect of three planting dates (September 20, October20 and November20) and four compound fertilizer rates (F1= 20% N, 20% P, 20% K .F2=19% N, 29% P, 11% K, F3= 14% N, 38% P, 10% K and F4=16% N, 9% P, 26% K) on vegetative growth, yield, yield quality, mineral composition in bulb onion and chlorophyll a and b in onion leaves. It is concluded from this study that 20 October date and F3 fertilizer Treatment (14% N, 38% P, 10% K) were the most effective for optimal prodution of Hassawi onion. There were significant differences in the vegetative growth yield and yield components between the different planting dates and fertilization. Planting on October 20 gave the better results than other dates, while F3 (14% N, 38% P, 10% K gave the best results for vegetative growth yield,and yield quality. Also 20 October planting date along with 14% N, 38% P, and 10% K gave better results for number of leaves/plant, leaf area/plant, dry/fresh weight%, average bulb weight (gm), bulb yield kgm^2 bulb shape index, N, P,. K chlorophyll a and chlorophyll b contents than other treatments.

Introduction:

Al-Hassawi onion plant (*Allium cepa L.*) is usually grown during winter and spring seasons. It is one of the most popular crops in Al-Hassa region of the Kingdom of Saudi Arabia .Al-Hassa oasis is one of the largest agricultural regions characterized by its arid climate (Al-Taher 1999). Onion plants cover an area of 2060 ha, out of which 824 ha are under irrigated cultivation. The soils of Al-Hassa region usually are low in available nitrogen and phosphorus Al-Barrak (1986).

Previous investigations showed that different compound fertilizers and different planting dates affected the growth characters, yield and yield components of Al-Hassawi onion. Rizk (1997) mentioned that increasing the rate of NPK fertilizers increased vegetative growth parameters and yield

of onion bulb. Vachhani and Patel (1993) found that plant height, number of leaves/plant, bulb weight, size and onion yield were highest with the application of 150 kg N ha-1. They also suggested that increasing P application increased the number of leaves/plant and bulb weight, size and yield, but K applications only increased the number of leaves/plant. Pandey and Ekbo (1991) found that P and K alone had no effect on the bulb diameter and yield, while Patel and Vachani (1994) suggested that onion bulb diameter, weight and yield increased with the application of 150 kg N/ha and 75 kg P_2O_5 ha-1, but showed no significant difference from the 150 kg K_2O ha-1. Soto (1989) mentioned that the critical levels for P and K in the soil were 15 mg L^{-1} (by a modified olsed solution) and 7 mg L^{-1}(by a Ca PO_4 solution) respectively. Pandey and Ekpo (1991) found that application rate of 160 kg N ha^{-1} gave a tall plant (63.9 cm) and high number of leaves/plant (13.0), while 120 kg N ha^{-1} produced best average weight and the highest yield of onion bulb. El. Marabaa *et al* (1975) found that the highest bulb yield and quality were obtained after seedling transplanting of 15 October compared with 15 September and 15 November. Farrag (1983) found that the best vegetative growth and bulb yield were obtained after15 September transplanting as compared to 15 October. Jayabharathi (1989) observed that best yield of onion bulb with an average weight of 114 gm was produced by the appling NPK at the rate of 75 kg^{-1}.

Almadini, *et al*. (2000) found that increasing the application of NPK fertilizers significantly increased the growth and yield of onion under Al-Hassa condition. The best values were found with 18 : 7 : 16 NPK fertilizer applied at the rate 714 kg ha^{-1}, which also resulted in the highest values of NPK contents in plants. However, the highest value of double/normal bulb was observed with 18 : 18 : 6 NPK fertilizer applied at the rate of 952 kg ha^{-1}. The highest value of soil NPK contents after harvest were observed under the highest applied rates of both fertilizers. Singh *et al*, (1989) mentioned that the application of 120 kg N and 50 kg K_2O ha^{-1} gave the talest plants, higher number of leaves/plant, best bulb weight, diameter and yield.

Materials and methods

A field experiment was carried out at the Agricultural and Veterinary Training and Research Station, King Faisal University, Al-Hassa, KSA

during 1999/2000 and 2000/2001. Forty five days onion seedling (AL-Hassawi cultivar) were used in this study . The experiment was conducted on a sandy soil (96% sand, 4% silt and clay) with low salinity (EC 1:2.5 = 1.6 dS m –1), slightly acid conditions (PH 1:2.5 = 7.50) and relatively low of CaCO3 (7%). The soil (i.e. the upper 0- 50 cm) contained low total nitrogen (N) and available phosphorus (P) as 0.003 %,and 4.95mg L –1, respectively). Physical and chemical properties of soil were determined by following the methods as described by Rowell (1994).

The evaluated sowing dates were : 20th sept. D1, 20th Oct. D2 and 20th Nov. D3, on both seasons .It should be 1999-2000 and 2000-2001 keeping in view the dates and crop duration .

Onion plants were fertilized with four NPK compound fertilizers at the rate of 714 kg NPK ha L –1. The fertilizer treatments were (20% N, 20% P, 20% K. F1), (19% N, 29% P, 11% K. F2), (14% N, 38% P, 10% K. F3) and 16% N, 9% P, 26% K. F4). A surface irrigation system was used to irrigate plants. The experiment consisted of twelve treatments and four replicates in a split plot design. The main plots were arranged for different planting dates, while the sub-plots, were for the fertilizers. The total area of each plot was 16 m^2 being divided into four rows with 8 m length and 50 cm width. The spacing between the plants was 12 cm. All other common farming practices for the onion in the Al-Hassa oasis were also performed. During the growing period and after harvesting, some plant growth measurements were taken to determine difference in vegetative growth, yield and yield quality as affected by different dates of plantig and the compound fertilizers. The measurements included number of leaves/plant, leaf area (cm^2), dry/fresh weight; plant%, neck bulb (cm), shape bulb index, average bulb weight (gm), total yield kg /m^2,and double/normal bulb. Chlorophyll a, b. were extracted with acetone 80% and measured colorimetrically according to Arnon (1949) in fourth leaf. They were completed on representative samples of 10 plants selected randomly from each plot. The N, P, K, and mineral contents in the Hassawi onion plant were analyzed by following the methods as described by Page, *et al*. (1982). Data obtained were subjected to approprite statistical analysis (Gomez and Gomez 1984).

Results and discussion

Vegetative growth

Mean values of different plant growth parameters ranged from 13.08-15.79 (leaves/plant), 916.83-1414.58 cm^2 (leaf area), 25.54-29.21cm^2 (dry/freash weight/plant) and 6.47-7.27% (neekshapeindex) in different planting dates (Table1). The plant growth parameter increased significantly for October than September and November planting dates, except neek shape index which was significantly higher for Novemberthan other planting dates (L.S.D 0.05 value given in table 1). The significant higher growth in October could be due top moderate climatic condition than either September (being relatively hot) or November (being relatively cool) months. Because extreme climatic. Conditions during September and November, might have advancly affected the condition and plant growth than October plantation. Similar results are observed by other investigators. Farrage (1983) who found the best vegetative growth of crop when transplanted after 1st September as compared to1st October under Egypt condition.

Yield and yield quality

Mean yield and yield quality parameters are given in table (2) which includes the average bulb weight (gm) bulb yield/m^2, bulb shape index and number of double/normal bulb %. It was found that 20th October planting date caused significant differences in the measured parameters of yield and yield quality as compared to the other planting dates except double/normal bulb % which was highest for 20 September date. This proposes that 20th September is the optimum to obtain the highest yield and best quality of onion plants in the Al-Hassa region. The results of this study agree with those obtained by El-Marabaa *et al.* (1975) who found that the highest bulb yield and quality were obtained after seedling 15 October as compared to that of 15 September and 15 November under Egypt condition.

Mean condition of N, P and K in the onion bulb and pigments in the leaves are shown in Table 3. The N, P and K contents in the onion bulb and chlorophyll a and b, in leaves increased with using 20 October than other dates. There were significant differences among different planting dates. This finding corresponds well with the vegetative growth and yield parameters obtained in this study, suggesting that the different dates caused different effects on Al-Hassawi onion plant. This is in line with the data

suggested by different investigators, who also observed that the N, P and K and chlorophyll a and b contents of AL-Hassawi onion plant, increased when planted on 20 October (El-Marabaa *et al* 1975).

Table (1)
Effect of planting date on vegetative growth parameters of Hassawi Onion during 1999/2000 and 2000/2001

Treatments	leaves/plant (No)	Leaf area (cm^2)	Dry/fresh Weight/plant (%)	Neck bulb (cm)
D1	13.95 b	1182.00 b	27.91 b	6.85 b
D2	15.79 a	1414.58 a	29.12 a	6.46 c
D3	13.08 c	916.83c	25.54 c	7.26 a
L.S.D.0.050	0.54	14.32	1.22	0.07

D1 = 20th September D2 = 20th October D3 = 20th November

Table (2)
Effect of planting dates on yield and yield compounents of Hassawi Onion during 1999-2000 and 2000-20001

Treatments	Average bulb Weight (gm)	Bulb Yield (kg/m^2)	Bulb shape index	No .of double/ Normal/bulb (%)
D1	185.16 b	2.86 b	7.91 b	15.62 a
D2	190.50 a	2.90 a	7.92 a	13.31 c
D3	183.16 c	2.77 c	7.69c	14.20 b
L.S.D. 0.050	2.54	0.08	0.06	0.50

D1 = 20th September D2 = 20th October D3 = 20th November

Table (3)
Effect of planting dates on N,. P,. K, andChlorophyll. a,b contents of onion bulb, during 1999/2000 and 2000-2001

Treatments	N %	P %	K %	Chlorophyl,a (mg/g F.W)	Chlorophyl,b (mg/g F.W)
D1	1.70 c	0.53b	0.17 b	0.35 b	0.34 b
D2	2.25a	0.55 a	0.18 a	0.36 a	0.35a
D3	2.18b	0.46 c	0.16 c	0.33 c	0.33c
L.S.D.0.050	0.12	0.01	0.01	0.01	0.01

D1 = 20th September D2 = 20th October D3 = 20th November

Effect of fertilizer types on onion plant vegetative growth :

Table 4 reveals the vegetative growth parameters (number of leaves/plant, leaf area plant (cm^2), dry/fresh weight % and neck shape index of the onion plants as affected by the fertilizer treatments. All the growth parameters increased significantly with F3 (14% N, 38% P, 10% K) than the other fertilizers treatments except the neck shape index which was significantly higher in F2 (19% N, 29% P, 11% K). This probably may be due to higher phosphorus contents of F3 than the other fertilizers. The results are in agreement with those obtained by Rizk (1997) who concluded that increasing the application rate of NPK fertilizer increased growth parameters of onion plant. Similarly, Vachhani and Patil (1993) found that plant height, and number of leaves/plant were the highest with the application of 150 kg N ha^{-1}. Pandey and Ekpo (1991) found that the application rate of 160 kg N ha^{-1} produced tall plant and high number of leaves/plant. Al-Madini *et al* (2000) found that increasing the application of NPK fertilizer significantly increased the plant growth.

Table (4)

Effect of compound fertilizer on leaves/plant, Leaf area, dry/fresh weight %., neck shape index during 1999/2000 and 2000/2001

Treatments	No. of leaves/ plant	Leaf area (cm^2/ plant)	Dry/fresh Weight (% /plant)	Neck shape index
F1	14.05b	1223.00 b	27.55b	6.63c
F2	14.27 b	1096.88c	27.38b	7.00a
F3	15.83 a	1436.55a	28.88a	6.83b
F3	15.83 a	1436.55a	28.88a	6.83b
F3	15.83 a	1436.55a	28.88a	6.83b
F4	12.94 c	928.11d	26.27c	6.98b
L.S.D. 0.050	0.67	16.53	1.40	0.08

F1 = 20% N, 20% P, 20% K. F2 = 19% N, 29% P, 11% K.
F3 = 14% N, 38% P, 10% K. F4 = 16% N, 9% P, 26% K.

Table (5)

Effect of compound fertilizer on bulb weight ,bulb yield, bulb shape index, and double/normal bulb, during 1999/2000 and 2000/2001

Treatment	Bulb weight (gm)	Bulb yield (Kg/ m^2)	Bulb shape Index	D/N Bulb %
F1	179.44d	2.577d	7.38d	15.055a
F2	185.88b	2.822b	7.97b	15.155b
F2	185.88b	2.822b	7.97b	15.155b
F3	197.44a	3.277a	8.14a	13.066a
F4	182.33c	2.711c	7.86c	14.255c
L.S.D. 0.050	2.99	0.10	0.07	0.58

F1 = 20% N, 20% P, 20% K. F2 = 19% N, 29% P, 11% K.
F3 = 14% N, 38% P, 10% K. F4 = 16% N, 9% P, 26% K.

Yield and yield quality:

Table (5) indicated that the highest mean values for bulb weight, bulb yield, and bulb shape index were obtained after using F3 (14% N, 38% P, 10% K), while F2 (19% N, 29% P, 11% K) treatment gave the highest mean values for double/normal bulb (1%) in both seasons. There were significant differences among all yield and quality parameters under different fertilizer types. These results are in correspondence with the findings of Jayabharathi (1989) who observed that best yield of onion bulb was obtained by applying NPK at the rate of 75 kg ha^{-1}. Al-Madini *et al.* (2000) mentioned that NPK fertilizer gave the highest yield of onion bulb under Al-Hassa region. Singh, *et al*. (1989) found that application of 120 kg N and 50 kg K_2O ha^{-1}, gave the best onion bulb and bulb shape index. Vachhanni and Patel (1993), Patel and Vachhani (1994) and Pandey and Ekpo (1991), also reported similar results.

Table (6) shows the effect of different fertilizers types on the mineral composition of onion bulb and chlorophyll a, b in the leaves. Data showed that there were significant differences among different fertilizer treatments . The N, P Kand chlorophyll a and b contents were significantly higher in F3 (14% N, 38% P, 10% K), and the lowest in F4 (18% N, 9% P, 26% K) except P % which was the lowest value with F1 (20% N, 20% P, 20% K) treatment

Table (6)

Effect of compound fertilizer on N. P. and K. contents in onion bulb and Chlorophyla ,b in onion leaves, during 1999/2000 and 2000-2001.

Treatments	N %	P %	K %	Chlorophyl,a (mg/g F.W)	Chlorophyl,b (mg/g F.W)
F1	2.00b	0.35c	0.168b	0.284c	0.260d
F2	2.01b	0.54b	0.168b	0.382a	0.373b
F3	2.24a	0.59a	0.178a	0.384a	0.383a
F4	1.91c	0.54b	0.160c	0.352b	0.358c
L.S.D. 0.050	0.15	0.02	0.02	0.01	0.06

F1 = 20% N, 20% P, 20% K. F2 = 19% N, 29% P, 11% K.
F3 = 14% N, 38% P, 10% K. F4 = 16% N, 9% P, 26% K.

Interaction between planting dates and compound fertilizers:

The interaction effects between dates and fertilization,on plant growth parameters were significant (Table 7). The best results of nitrogen, phosphorus and potassium contents were obtained in onion bulb and chlorophyll a, and b in the leaves during the two cropping seasons. Highest mean values of leaves/plant, leaf area/plant and dry/fresh weight %, were obtained for 20 October with F3 (14% N, 38% P, 10% K), while the highest value for neck shape index was obtained 20 November with F2 (19% N, 29% P, 11% K). The results agree with those obtained, Rizk (1997), Vachhanni and Patel (1993), and El-Marabaa *et al* (1975), Who reported similar results on onion plants.

Yield and yield quality:

Data in table (8) summarized the effect of planting dates and fertilization on onion yield and its quality. The highest mean value of average bulb weight, bulb yield m^2 and bulb shape index were obtained for 20 October with F3 (14% N, 38% P, 10% K) treatments. While the highest value of double/normal bulb % was obtained with 20 September with F2 (19% N, 29% P, 11% K). Similar results were obtained by Patel and Vachhanni (1994) who reported that onion bulb diameter, weight and yield increased with application of 150 kg N ha^{-1} and 75 kg P_2O_5 ha^{-1}, Pandey and Ekpo (1991), Farrage (1983). Jayabharathi (1989) also reported similar results on onion yield.

N, P and K contents in onion bulb and chlorophyll a and b in onion leaves:

Table (9) indicate the effect of different planting dates and different fertilizers on mineral content of bulb and chlorophyll a and b in onion leaves.

The best results for N%, P%, K% contents of bulb and chlorophyll a were obtained for 20 October with F3 (14% N, 38% P, 10% K), while chlorophyll b was the highest for 20 October with F2 (19% N, 29% P, 11% K). Date also show that there were significant differences between dates and fertilization in the measured parameters. Comparable results were obtained by Al-Madini *et al* (2000) who found that N, P, and K contents in the onion plants increased after the application of NPK fertilizer, while

Hamaiel, *et al*. (1995) mentioned that calcium nitrate at 100 kg N/feddan significantly increased chlorophyll a and b in table beet.

In conclusion, Hassawi onion plants showed differential response to different planting dates and different types of NPK compound fertilizers. Best response, as observed by the vegetative growth and yield quality parameters of Hassawi onion, was obtained when planting in 20 October with F3 fertilizer (14% N, 38% P, 10% K). However, the 14% N, 38% P, 10% K fertilizer with 20 October gave better results than the other treatments, which leads us to recommend the former fertilizer for Al-Hassawi onion plants under the dry conditions of Al-Hassa region.

Table (7)

Effect of planting dates and compound fertilizers on leaves/plant, leaf area, dry/fresh weight and neck shape index during 1999/2000 and 2000/2001.

Treatments		Number of leaves/plant	Leaf area (cm^2/plant)	Dry/fresh weight (%)	Neck shape index
D1	F1	13.66	1222.66	28.83	6.30
	F2	13.83	1125.33	29.33	6.86
	F3	15.50	1419.66	30.00	7.10
	F4	12.83	960.33	27.66	7.16
D2	F1	15.50	1472.66	27.33	6.30
	F2	16.50	1377.00	27.83	6.73
	F3	17.50	1773.00	30.66	6.30
	F4	13.00	1035.66	26.50	6.53
D3	F1	13.00	973.66	26.50	7.30
	F2	12.50	788.33	25.00	7.40
	F3	14.50	1117.00	26.00	7.10
	F4	12.33	788.33	24.66	7.26
L.S.D. 0.050		1.17	28.63	2.43	N.S

F1 = 20% N, 20% P, 20% K. F2 = 19% N, 29% P, 11% K.
F3 = 14% N, 38% P, 10% K. F4 = 16% N, 9% P, 26% K.
D1 = 20th September D2 = 20th October D3 = 20th November

Table (8)

Effect of planting dates and fertilizer on bulb weight bulb yield, bulb shape index and double/normal bulb %, during 1999/2000 and 2000/2001.

Treatments		Bulb weight gm	Bulb yield kg/m^2	Bulb shape index	No. of double/ No. of bulb %
D1	F1	177.66	2.36	7.500	16.16
	F2	187.33	2.86	7.86	17.00
	F3	195.00	2.23	8.26	14.00
	F4	180.66	2.80	8.03	15.33
D2	F1	184.00	2.76	7.40	13.70
	F2	186.66	2.73	7.86	14.06
	F3	205.00	3.50	8.30	12.23
	F4	186.33	2.60	8.13	13.26
D3	F1	176.66	2.40	7.26	15.30
	F2	183.66	2.86	8.20	14.40
	F3	192.33	3.100	7.86	12.96
	F4	180.00	2.73	7.43	14.16
L.S.D.0.050		5.17	0.16	0.13	N.S

F1 = 20% N, 20% P, 20% K. F2 = 19% N, 29% P, 11% K.
F3 = 14% N, 38% P, 10% K. F4 = 16% N, 9% P, 26% K.
D1 = 20th September D2 = 20th October D3 = 20th November

Table (9)

Effect of planting dates and compound fertilizer on N. P. and K. in onion bulb and chlorophyll A and B in the onion leaves,during 1999/2000 and 2000/2001

Treatments		N %	P %	K %	Chlorophyl . a (mg/g F.W)	Chlorophyl b (mg/g F.W)
D1	F1	1.66	0.330	0.163	0.303	0.266
	F2	1.71	0.586	0.170	0.390	0.386
	F3	1.77	0.620	0.183	0.376	0.380
	F4	1.66	0.610	0.153	0.360	0.380
D2	F1	2.13	0.356	0.176	0.286	0.260
	F2	2.03	0.593	0.173	0.380	0.388
	F3	2.53	0.643	0.186	0.396	0.383
	F4	2.03	0.620	0.173	0.360	0.353
D3	F1	2.23	0.376	0.166	0.263	0.253
	F2	2.30	0.440	0.163	0.383	0.376
	F3	2.43	0.526	0.166	0.373	0.356
	F4	2.03	0.503	0.153	0.356	0.343
L.S.D.0.050		0.23	0.02	0.01	0.01	0.01

F1 = 20% N, 20% P, 20% K. F2 = 19% N, 29% P, 11% K.
F3 = 14% N, 38% P, 10% K. F4 = 16% N, 9% P, 26% K.
D1 = 20th September D2 = 20th October D3 = 20th November

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تأثير مواعيد الزراعة والأسمدة المركبة على النمو والانتاج وجودتة فى البصل الحساوى تحت ظروف منطقةالاحساء

محمد بن عبد العزيز العبد السلام و على فتحى حمايل

كلية العلوم الزراعية والاغذية – جامعة الملك فيصل

الأحساء - المملكة العربية السعودية

أجريت تجربة حقلية خلال عامى ١٩٩٩/٢٠٠٠,٢٠٠٠/٢٠٠١ لدراسة تأثير ثلاثة مواعيد زراعة (٢٠ سبتمبر ، ٢٠ اكتوبر ، ٢٠ نوفمبر) و أربع معدلات مختلفة من الاسمدة المركبة (٢٠٪ N+٢٠٪ P+٢٠٪ K ; ١٩٪N +٢٩٪P+١١٪K ; ١٤٪N +٣٨٪P+١٠٪K ;١٦٪N+٩٪ P+٢٦٪ K) على النمو الخضرى والمحصول وجودتة والمحتوى المعدنى فى البصل الحساوي ومحتوى الأوراق من الكلوروفيلات أ ،ب. وقد اشارت نتائج هذة الدراسة الى الآتى :

أعطى ميعاد الزراعة فى ٢٠ اكتوبر أفضل نتائج فى النمو الخضرى والمحصول بالمقارنة بالمواعيد الأخرى بينما أعطى التسميد بالسماد المركب (١٤٪ N+٣٨٪ P + ١٠٪K) افضل النتائج فى النمو الخضرى ومحصول الابصال بالمقارنة بالاسمدة الأخرى. أشارت النتائج الى وجود فروق معنوية فى النمو الخضرى والمحصول وجودتة بين المعاملات المختلفة (مواعيد الزراعة والتسميد). أعطى التفاعل بين المعاملة بالزراعة فى ٢٠ أكتوبر والتسميد (١٤٪ N+٣٨٪P +١٠٪ K) أفضل النتائج بالنسبة لكلا من عدد الأوراق للنبات ،المساحة الورقية للنبات ،الوزن الجاف/الوزن الطازج للنبات ٪ ، متوسط وزن البصلة بالجم، محصول الأبصال بالكجم للمتر المربع ،شكل البصلة ومحتوى النبات من N,P,K ومحتوى كلوروفيل أ وكلوروفيل ب بالمقارنة بالمعاملات الأخرى.