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Effect of Sowing Date and Nitrogen Fertilizer Level on the Quality of Wheat Grown in the Eastern Region of Saudi Arabia

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ABSTRACT. Wheat (*Triticum vulgare* L.) cultivar Arz was grown under three levels of nitrogen fertilizer and four sowing dates between early November and late December of two growing seasons (82/83 and 83/84). The harvested grains were subjected to quality tests. Kernel weight increased with early sowing, but decreased with the increasing level of nitrogen fertilizer. The Pelshenke test results did not show any consistent effect of treatments but gluten and protein contents increased significantly with increase in fertilizer nitrogen level. The seed hardness test showed softness in the early November sowing, apparently due to rainfall in the first season during the late stages of maturity. This rain also caused black eye wheat and low maximum viscosity, which was detected by the amylograph, indicating minor sprouting and high diastatic activity. A decrease in the pasting temperature of the flour was noticed with an increase in nitrogen fertilizer level. High water absorption of the flour was noticed with the early sowing and higher nitrogen level. The dough developing time showed an increasing trend with increased nitrogen fertilizer, but no effect of sowing date was noticed on the dough development. The dough stability was generally low and inconsistent. Considering all quality parameters it seemed that this variety showed a reasonable response to the increase in nitrogen fertilizer indicating that its quality potential was almost reached under the hot arid conditions of the area. This wheat falls in the range of medium hard wheat. Early sowing improved the quality of wheat, provided that no late rains coincide with the harvest time.

Wheat (*Triticum vulgare* L.) is one of the most popular grain crops in the world and has recently become one of the leading grain crops in the Kingdom of Saudi Arabia. Within the last six years the production of wheat in the Kingdom has increased from three thousand to one million and three hundred thousand tonnes per year. With this level of production quality must be stressed.

The utilization of wheat tends to determine the quality measures used, but the basic tests are almost the same for all types of wheat. Generally wheat quality is determined by measuring the following: Protein content, gluten quantity and quality, kernel hardness, flour yield and flour rheological properties. Such properties are affected by environmental conditions as well as genetic factors. The effect of nitrogen fertilizer on yield has been studied extensively, but its effect on quality has been studied but much less.

Each wheat variety has a certain protein as well as gluten yield potential. This potential can be reached under optimum growing conditions. Nitrogen fertilization is one of the main factors affecting protein as well as gluten within the potential. Environmental conditions associated with the sowing date have also been considered a major factor affecting wheat grain quality. Shallenburger and Clark (1924) reported a range from 7.5-19.6% of protein in samples of Marquis wheat grown in different locations. It is generally known that climatic conditions determine the difference between spring and winter wheats, and to a large extent between soft and hard wheats (Pyler 1973). According to Swanson (1941), local weather conditions with respect to temperature and rainfall, as well as soil properties, are among the factors affecting hardness and softness. The influence of such factors as climate, soil, irrigation and fertilizer on wheat composition has been reviewed by Bailey (1925).

On varying sowing date and nitrogen fertilizer on wheat, Alessi *et al.* (1979) observed that late sowing reduced test weight, flour yield, baking absorption, but increased wheat protein content as compared with early sowing. Dubetz and Gardner (1980), Duwayri (1978) and Strong and Cooper (1978) reported an increase of crude protein in wheat grain with increased nitrogen fertilizer, but they also observed that the amino acid composition was altered. Pelikan and Dubas (1979) found that the application of nitrogen fertilizer to wheat in three dressings increased grain protein content by 1% and gluten content by 2.6-3.5%. However, Pelikan and Stiskal (1975) found that an increase in nitrogen rate increased the proportion of the grain gluten fractions and prolamins and gluten relative to the total protein, while those of the albumins and globulins fell moderately. Dubas *et al.* (1974) reported that nitrogen fertilizers affected protein and gluten content as well as baking quality and farinograph indices. Nelson *et al.* (1978) reported that some wheat cultivars were affected by nitrogen fertilizers whereas others were not. Singh *et al.* (1974) showed that increasing the N fertilization rate resulted in increases in grain protein, gluten, pelshenke value, water absorption, and sedimentation values, but a decline in flour yield. Some cultivars, however, showed high all-purpose flour recovery and nutritive value.

Brunetti *et al.* (1976) found that Durum wheat showed a positive response in protein content to nitrogen fertilization up to 200 kg N/ha. They also reported that nitrogen fertilization mainly increased the gliadin and the glutenin fractions which are the gluten forming proteins. Syme *et al.* (1976) concluded that all cultivars they studied, when fertilized with nitrogen, qualified for similar premium payments per unit of land area and proved by simplified economic analysis that it is most profitable to grow and fertilize high yielding cultivars.

Contrary to the results reported by these workers, Elonen *et al.* (1975) found that in a four-year trial the protein quality of wheat grain deteriorated following high nitrogen fertilization. Such results were confirmed by Duffus and Slaughter (1980). Hyza and Smocek (1972) observed that the application of fertilizer increased gluten content but gluten quality was adversely affected. This result indicated the negative correlation between increase in quantity and quality of the gluten proteins. Similar results were obtained by Simon and Prugar (1972).

The objective of this study was to determine the effect of sowing date and level of fertilizer nitrogen on the quality of wheat grown in Al-Hassa area. This study is a follow up of the paper on the effect of planting date and levels of fertilizer nitrogen on the growth and yield of wheat in the Eastern Region of Saudi Arabia (Makki *et al.* 1987).

Materials and Methods

The experiment included four sowing date treatments *viz.* early November, late November, early December and late December in each of the two growing seasons (82/83 and 83/83). The fertilizer treatments were 40, 80, and 120 kg N/ha given in the form of urea (46%) as post-sowing application; about two weeks after sowing. The experimental design used was a four replication split-plot design in which the sowing dates occupied the whole-plots and the fertilizer levels occupied the sub-plots.

Wheat variety Arz, one of the standard commercial varieties, was sown in each sub-plot, at the rate of 100 kg/ha. The seeds were drilled by hand in rows 20 cm apart. Resowing of missing parts was done within the first week after planting. The fertilizer was broadcasted by hand between the rows and was watered in by immediate irrigation. Weeds were effectively controlled by hand and adequate waterings were given at weekly intervals. Rainfall and temperature were as follows:

	1982		1983			
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
Rainfall (total amount mm)	13.5	15.5	0.00	0.00	50.0	13.2
Monthly daily mean temp (°C)	19.62	16.0	19.62	14.41	17.48	N.A.

	1982		1983			
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
Rainfall (total amount mm)	00.00	00.00	00.00	00.00	25.1	0.00
Monthly daily mean temp (°C)	21.88	15.86	13.86	15.22	31.15	28.31

After harvest the seeds were cleaned and tested as follows:

1. *1000 Kernel Weight*

A thousand kernels were counted using a Borrow Precision Seed Counter. Triplicate samples were used and the average weight was recorded to 2 decimal places.

2. *Black Eye (Sick Wheat)*

A wheat kernel which has a black spot at the attachment point (hilum) resulting from mould growth in the field was considered black eye or sick wheat. Using thousand wheat kernels, black eye kernels were separated and weighed. The results were recorded as percentage black eye wheat.

3. *Pelshenke Test*

This test indicates the gas retention power of the flour which is controlled by the gluten strength. The stronger the gluten the higher the gas retention power, *i.e.* the longer the time the dough ball takes to dicentigrate. This test was conducted according to the AACC methods of analysis (2) method No. 56-50.

4. *Gluten Washing*

Gluten was hand washed according to AACC Method No. 38-10. Wet gluten is the wet elastic mass remaining after washing all other flour components. Dry gluten is the oven dry gluten. The percentage dry or wet gluten is based on the flour weight used for gluten washing.

5. *Proximate Analysis*

A hundred grams of wheat kernels were ground in a sample grinder using a 0.8 mm sieve. The ground wheat meal was used for the determination of crude protein, crude fat, ash and moisture according to the AACC methods of analysis methods No. 46-10, 30-10, 08-03, 44-16, respectively.

6. *Seed Hardness*

Six grams of seeds were used for the determination of seed hardness using a Brabender automatic micro-hardness tester. The results were recorded as the number of seconds required to grind four grammes of wheat seeds. The apparatus was set on an automatic time counter connected to an automatic balance that stopped the counter as soon as four grammes of seeds were ground. The seeds were classified as hard or soft according to the time taken for grinding four grammes of seeds. The hard seeds require a short time to grind while the soft seeds require longer time as the later sticks to the grinder teeth.

7. *Flour Extraction*

Samples of 450 g of wheat kernels were used for milling. The kernels were cleaned and tempered at 16% moisture by adding the required amount of water to each sample separately. The samples were then closed in separate containers at room temperature for 24 hr. after which they were milled in a Brabender Quadrumat Junior Mill.

8. *Rheological Tests*

Rheological properties of the flour were tested by the Brabender amylograph and the Brabender farinograph according to AACC methods of analysis methods No. 22-10 and 54-21, respectively. A 50 g mixer head was used in the case of the farinograph.

9. *Statistical Analysis*

Results were subjected to analysis of variance (Steele and Torrie 1980).

Results and Discussion

There was a clear and significant tendency for Kernel weight to increase with early sowing, indicating full and larger kernels (Table 1) confirming the results of

Table 1. Effect of sowing dates and levels of nitrogen on weight of 1000 seeds (g)

Levels of fertilizer N	Sowing dates				Mean
	Early Nov.	Late Nov.	Early Dec.	Late Dec.	
40 kg/ha	51.04	43.69	43.71	38.19	43.90
80 kg/ha	49.81	42.66	41.57	38.30	43.08
120 kg/ha	48.02	39.30	40.36	38.55	41.55
Mean	49.62	41.88	41.54	38.34	

LSD (.05) for levels of N = 1.93
LSD (.05) for sowing date = 2.21
LSD (.05) for sowing date X N = 2.11

Allesi *et al.* (1979), and decrease in kernel weight with an increase in fertilizer level. This may be due to the fact that the increase in the fertilizer level resulted in plants with more tillers, spikelets and kernels per spikelet and higher yield but smaller seeds. The yields were 2.92, 3.49 and 4.04 ton/ha for 40, 80 and 120 kg N/ha treatments, respectively.

Results of the Pelshenke test (Table 2) were so close that no noticeable differences could be detected among treatments. The values ranged between 41 and 50 seconds for desintegration of the ball, indicating medium type wheat, *i.e.* falling between soft and hard wheats.

Table 2. Results of Pelshenke Test as affected by sowing date and nitrogen treatments (min)

Levels of fertilizer N	Sowing dates				Mean
	Early Nov.	Late Nov.	Early Dec.	Late Dec.	
40 kg/ha	47	44	50	48	47
80 kg/ha	48	47	48	48	48
120 kg/ha	41	42	49	50	45
Mean	45	44	49	49	

LSD (.05) for levels of N = N.S.
LSD (.05) for sowing date = N.S.
LSD (.05) for sowing date X N = N.S.

There was significant increase in the gluten content with an increase in the level of nitrogen (Table 3). The effect of sowing date was not consistent nor showed any general trend in the two seasons. The values were, however, higher in the second season. It is generally known however, that an increase in nitrogen level does not necessarily result in an increase in quantity or quality of gluten as the extra nitrogen may form prolamin rather than the gluten forming proteins (glaidin and glutenin) (Duffus and Slaughter 1980). But Singh *et al.* (1974) and Brunetti *et al.* (1976) reported the increase of gluten with the increase of N fertilization.

Seed hardness results in the early November sowing date were for all levels of nitrogen, higher than that of all other dates, indicating more softness with the early sowing (Table 4). This may be attributed to the effect of the late rains which fell on the crops just before harvest. The values of the hardness test generally, indicated that this wheat is of the hard type as the grinding time falls between 31 and 42 sec/4 g. The seed hardness values of season 83/84 crop were generally lower, indicating an increase in hardness of the grain. This hardness can also be associated with the increase in protein content, and possibly the low rainfall which characterized the

Table 3. Effect of sowing dates and levels of nitrogen on the percentage of gluten

Levels of fertilizer N	Sowing dates				Mean
	Early Nov.	Late Nov.	Early Dec.	Late Dec.	
40 kg/ha					
*W–	27.31	27.64	27.40	28.04	27.60
**D–	10.41	9.04	10.27	10.34	10.02
80 kg/ha					
W–	26.82	28.29	28.69	29.93	28.43
D–	10.00	9.86	10.90	11.36	10.53
120 kg/ha					
W–	31.24	29.51	27.89	30.29	29.73
D–	11.79	10.89	10.80	11.66	11.29
Mean					
W–	28.46	28.48	27.90	29.42	
D–	10.73	9.94	10.66	11.12	

* W = Wet gluten: N.S.
** D = Dry gluten:
LSD (.05) for levels of N = 0.69
LSD (.05) for sowing date = N.S.
LSD (.05) for sowing date X N = N.S.

Table 4. Effect of sowing dates and levels of nitrogen on kernel hardness (sec)

Levels of fertilizer N	Sowing dates				Mean
	Early Nov.	Late Nov.	Early Dec.	Late Dec.	
40 kg/ha	40	44	35	33	36
80 kg/ha	39	35	34	34	36
120 kg/ha	42	34	31	34	35
Mean	40	34	33	34	

LSD (.05) for sowing date = 1.8
LSD (.05) for levels of N = N.S.
LSD (.05) for sowing date X N = N.S.

second season. It is not advisable, however to take seed hardness as a conclusive measure of quality as it could be affected by moisture content (Pomeranz *et al.* 1985). Also the hardness could vary for other reasons as well, such as Kernel size, weight or density (Gaines 1986).

Rain affected the percentage of sick (black eyed) wheat. In 1982-83 season, sick wheat increased significantly with earliness of sowing date as more seeds were exposed, at a mature stage, to the effect of rain on the early planting (Table 5a). In 1983-84 season, the percentage of sick wheat dropped drastically for all treatments due to the lack of rain at the mature stage of the kernels (Table 5b). The mean of sick wheat for early November sowing dropped from 16.46 in 1982-83 to 0.05% in 1983-84. Sick wheat has not been reported in dry areas of the world nor in the Kingdom before.

Table 5a. Effect of sowing dates and levels of fertilizer nitrogen on the percentage of sick wheat (82/83 season)

Levels of fertilizer N	Sowing dates				Mean
	Early Nov.	Late Nov.	Early Dec.	Late Dec.	
40 kg/ha	13.75	8.00	3.50	00	6.31
80 kg/ha	17.50	8.75	2.25	5.43	8.48
120 kg/ha	18.13	10.63	1.75	0.50	7.75
Mean	16.46	9.13	2.50	1.98	

LSD (.05) for levels of N = N.S.
LSD (.05) for sowing date = 4.25
LSD (.05) for sowing date X N = N.S.

Table 5b. Effect of sowing dates and levels of fertilizer nitrogen on the percentage of sick wheat (83/84 season)

Levels of fertilizer N	Sowing dates				Mean
	Early Nov.	Late Nov.	Early Dec.	Late Dec.	
40 kg/ha	0.08	0.90	2.9	0.20	1.02
80 kg/ha	0.05	0.30	1.65	0.40	0.60
120 kg/ha	0.025	0.93	1.35	0.28	0.65
Mean	0.05	0.71	1.97	0.29	

LSD (.05) for levels of N = N.S.
LSD (.05) for sowing date = N.S.
LSD (.05) for sowing date X N = N.S.

The proximate analysis indicated a normal average type wheat with low protein content (Table 6). The protein content was generally higher in 1983-34 for all treamtnets than 82-83. It is clear, however, that the protein content showed a significant increase with an increase in the level of nitrogen. This increase was followed as mentioned earlier, by a corresponding increase in gluten content. These results confirm the results of Dubas *et al.* (1974). But Nelson *et al.* (1978) reported that some of the cultivars are affected by N-fertilizer while others are not. We believe that all cultivars are affected by N fertilizer resulting in protein increase provided that they did not reach their maximum protein potential. The moisture content of the kernels was lower in the second season, probably due to the lack of rain at the late maturity stage.

Table 6. Proximate analysis of wheat grain obtained from the different sowing date and fertilizer nitrogen treatments
(percentage on D.M. basis)

Level of fertilizer	**40 kg N/ha**				**80 kg N/ha**				**120 kg N/ha**			
Sowing date	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**
Moisture	9.69	9.06	9.09	8.78	8.78	9.71	8.62	9.24	9.77	9.24	9.05	8.67
Protein	9.70	8.70	8.4	8.60	8.98	9.45	9.47	9.56	10.21	10.28	10.32	10.12
Ash	1.33	1.35	1.52	1.30	1.25	1.20	1.35	1.36	1.30	1.29	1.28	1.34
Fat	2.39	2.30	2.52	2.43	2.43	2.24	2.15	2.00	2.70	2.50	2.70	2.27

Protein: LSD (.05) for levels of N = 1.33
LSD (.05) for sowing date = N.S.
LSD (.05) for sowing date X N = N.S.
Others: N.S.

Amylograph readings showed a clear effect of sowing dates. The flour obtained from early sown wheat gave very low maximum viscosity readings (Figs. 1-3). Such readings are due to high diastatic activity. This resulted in sick wheat, also, minor sprouting which initiated the production of α-amylase which attacks the starch granules, thereby giving low maximum viscosity readings. High levels of α-amylase will lower the quality of bread.

Maximum viscosity readings increased with a delay in the sowing date indicating a decrease in diastatic activity for all the nitrogen fertilization levels (Table 7). Although there was some variation in the maximum viscosity readings with change in nitrogen level, no clear trend could be established.

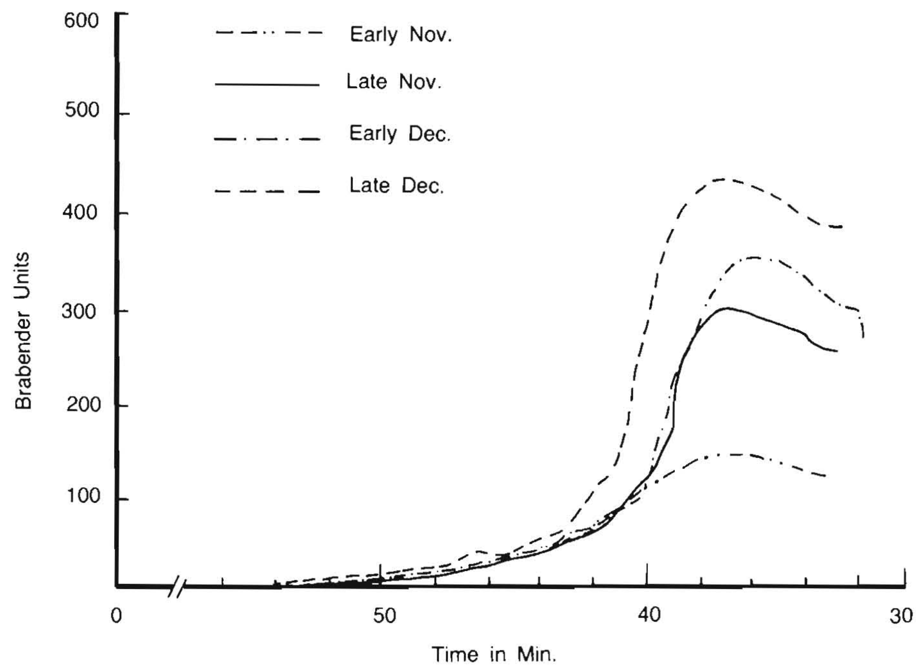

Fig. 1. Effect of Sowing Date on Flour Amylogram Readings of Wheat Grown with 40 kg N/ha.

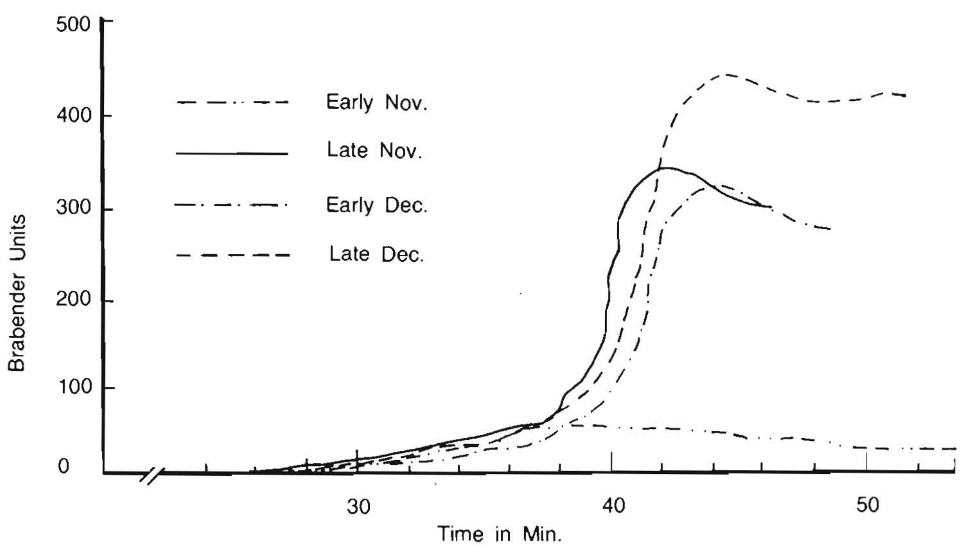

Fig. 2. Effect of Sowing Date on Flour Amylogram Readings of Wheat Grown with 80 kg N/ha.

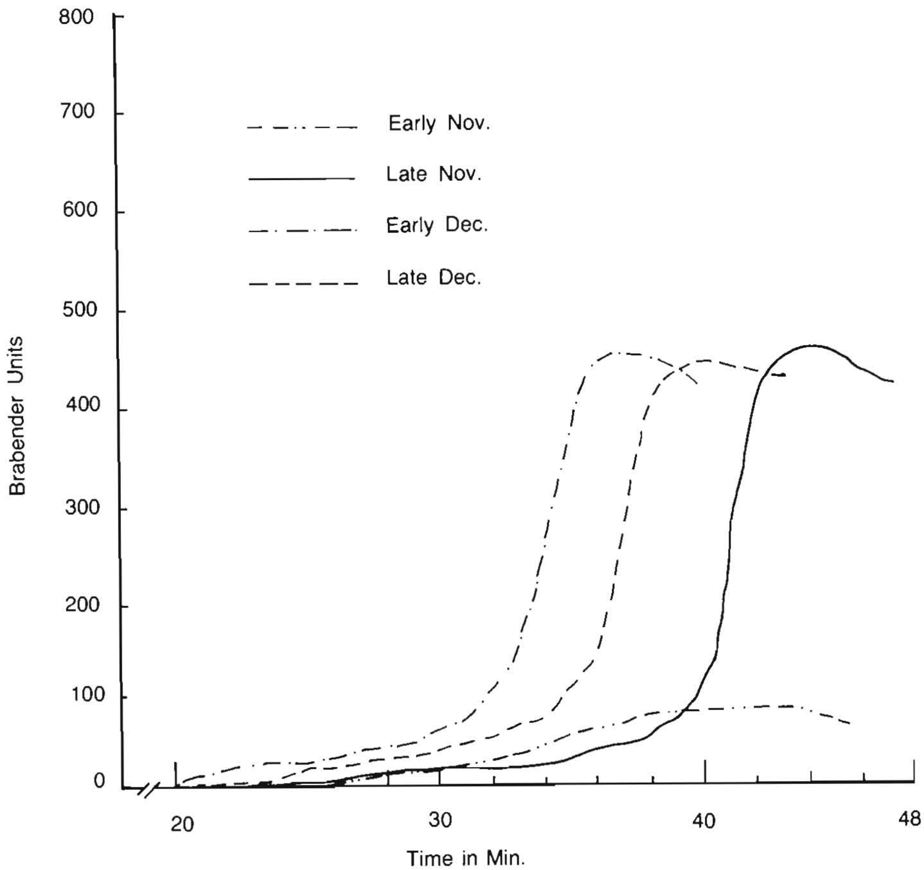

Fig. 3. Effect of Sowing Date on Flour Amylogram Readings of Wheat Grown with 120 kg N/ha.

A decrease in the pasting temperature of the wheat flour was generally noticed with the increase in nitrogen level (Table 7). The pasting temperature of the high nitrogen level was noticeably lower (33°C).

The flour yield (Table 8) was in the range 65.5-72.2%. The medium fertilizer nitrogen level in the late sowing date gave the highest flour extraction rate. The results obtained indicated that no relationship between flour yield and sowing date or nitrogen treatments could be established.

The farinograph results given in Table 9 showed slight differences between water absorption of the flours of the different treatments. Higher nitrogen level with the early sowing date showed higher water absorption. The dough developing

Table 7. Effect of sowing date and fertilizer nitrogen level on Amylograph Readings

Sowing date	*N. level*	Pasting		Maximum viscosity		
		Temp. (°C)	Time (min)	Temp. (°C)	Time (min)	B.U.
A	40 kg/ha	43.5	29	65.5	43	150
B		43.5	29	61.5	41	300
C		43.5	29	63.0	42	360
D		42.0	28	61.6	41	440
A	80 kg/ha	40.5	27	55.5	37	60
B		39.0	26	63	42	342
C		42.0	28	66	44	320
D		42.0	28	66	44	440
A	120 kg/ha	39.0	26	64.5	43	85
B		39.0	26	63	42	460
C		37.5	25	57	38	450
D		33.0	22	54	36	460

Table 8. Effect of sowing date and nitrogen level on flour yield

Sowing date	Nitrogen level	% Flour (extraction rate)
A	40 kg/ha	65.50
B		71.55
C		67.28
D		66.56
A	80 kg/ha	69.77
B		66.59
C		70.04
D		72.22
A	120 kg/ha	67.48
B		69.04
C		69.25
D		69.93

Table 9. Effect of nitrogen level and sowing date on farinograph readings of the extracted flour

Sowing dates	N level	Water absorption %	Developing time (min)	Dough stability (min)
A	40 kg/ha	66.0	2.0	2.5
B		65.2	1.0	2.0
C		65.2	1.5	3.0
D		64.0	1.5	3.5
A	80 kg/ha	66.0	1.5	2.5
B		63.8	2.0	2.5
C		62.0	1.5	3.0
D		62.4	1.5	4.0
A	120 kg/ha	68.0	2.0	4.0
B		67.2	3.5	2.0
C		65.0	1.5	3.5
D		64.4	4.0	3.0

time showed an increasing trend with the increased nitrogen and no effect of sowing date. Dough stability was generally low and inconsistent in effect. Considering all three parameters, as quality indicators, it seems that, increased nitrogen has resulted in a slight improvement in the quality of the wheat which indicates that the quality potentials of this variety are not too far to reach by applying more nitrogen/ha.

Conclusions

This wheat cultivar proved to be of a medium seed hardness, gluten quality and content. It is therefore, a medium hard wheat good for bread making. It has high water absorption, which is considered to be an economical factor for the bakers.

The nitrogen fertilizer has resulted in improving this wheat quality through increasing protein, gluten content, water absorption and dough strength.

The early sowing date has resulted in a higher 1000 kernel weight which leads to higher ratio of indosperm/bran.

It is therefore advisable to consider early November as the best sowing date for this wheat cultivar provided that no rainfalls at harvest time, and 120 kg N/ha as the most suitable fertilizer level.

References

Alessi, J., **Power, J.F.**, and **Sibbitt, L.D.** (1979) Yield quality and nitrogen fertilizer recovery of standard and semi-dwarf spring wheat as affected by sowing date and fertilizer rate, *J. Agric. Sci. U.K.* **93**(1): 87-93.

American Association of Cereal Chemists (1961) *Methods of Analysis*, Am. Assoc. of Cereal Chemists, St. Paul, MN, U.S.A.

Bailey, C.H. (1925) *The Chemistry of Wheat Flour*, Chemical Catalog Co., New York, U.S.A.

Brunetti, N., **Ferrandi, L.**, **Bozzini, A.** and **Mosconi, C.** (1976) Effect of nitrogen fertilization on nitrate reductase activity on grain, straw and protein yields in durum wheat, *Rivista di Agronomia* **10**(3): 171-177.

Dubas, F., **Pelikan, M.** and **Skubalova, J.** (1974) Investigation of technological quality of winter wheat at a high level of nitrogen fertilization (English summary), *Acta Universitatis Agriculturae, Brno, Facultas Agronomica, A.* **22**(2): 235.

Dubetz, S. and **Gardiner, E.E.** (1980) Protein content and amino acid composition of seven wheat cultivars subjected to water stress effects of nitrogen fertilizer treatments, *J. Plant Nutr.* **2**(5): 517-523.

Duffus, C. and **Slaughter, C.** (1980) *Seeds and Their Uses*, John Wiley and Sons, Chichester, U.K., p. 46.

Duwayri, M. (1978) Effect of nitrogen fertilization on yield and quality of grain of different wheat varieties, *Dirasat, Natural Science* **5**(2): 77-85.

Elonen, P., **Rinne, S.L.** and **Suomela, H.** (1975) Influence of irrigation and nitrogen fertilization on grain yield and some baking quality characteristics of spring wheat, *J. Sci. Agr. Soc. Finland* **47**(3): 166-180.

Gaines Charles, S. (1986) Texture (hardness and softness) variation among individual soft and hard wheat kernels, *Cereal Chem* **63**(6): 479-484.

Hyza, V. and **Smocek, J.** (1972) The influence of late nitrogen fertilization on grain wheat quality in the F_3 generation (English summary), *Rosttinna Vyroba* **18**(10): 1041.

Makki, Y.M., **Burhan, H.O.**, **Al-Tahir, O.A.** and **Mustafa, A.I.** (1987) Effects of planting date and levels of fertilizer nitrogen on the growth and yield of wheat in the eastern region of Saudi Arabia, *Arab Gulf J. Scient. Res.* **5**: (in press).

Nelson, L.R., **Young, C.T.**, and **Bitzer, M.J.** (1978) Yield and protein quality of five soft red winter wheat cultivars as affected by nitrogen fertilization rate, *Comm. Soil Sci. Plant Anal.* **9**: 415-428.

Pelikan, M. and **Dubas, F.** (1979) Effect dusikateho hrojeni ozime psenice a jeho economicka zhodnoceni jakost zrna (English summary), *Rosttinna Vyroba*, **25**(2): 167.

Pelikan, M. and **Stiskal, J.** (1975) Changes in the representation of the protein fractions of winter wheat with increasing nitrogen fertilization (English summary), *Acta Universitatis Agriculturae, Brno, A.* **23**(1): 57.

Pomeranz, Y., **Afework, S.** and **Lai, F.S.** (1985) Determination of hardness in mixtures of hard red winter and soft red winter wheats. I. Bulk, Samples, *Cereal Chem.* **62**(1): 41-46.

Pyler, E.J. (1973) *Baking Science and Technology*, Vol. 1, p. 292, Siebel Publishing Co. Chicago, III. U.S.A.

Shallenberger, J.H. and **Clark, J.A.** (1924) Milling and baking experiments with American Wheat Varieties, *U.S. Dep. of Agric. Bull.* 1183.

Simon, J. and **Prugar, J.** (1972) The effect of irrigation and nitrogen fertilizing on the quality of Winter wheat grain (English summary), *Rosttina Vyroba* **18**(10): 1051-1058.

Singh, R.P., **Anderson, R.G.** and **Austin, A.** (1974) Quality characters of dwarf wheat varieties "Sharbati Sonora" and "Kalyan Sona" influenced by nitrogen fertilization, *Indian J. Agric. Sci.* **44**(11): 731-735.

Steele, R.G.D. and **J.H. Toorie** (1980) *Principles and Procedures of Statistics*. McGraw-Hill Book Co., New York.

Strong, W.M. and **Cooper, J.E.** (1978) *Protein response to nitrogen fertilizer,* Queensland Wheat Research Institute Biennial Report (1976-1978).

Swanson, C.O. (1941) *Bakers Digest* **16:** p. 127.

Syme, J.R., Mackenzie, J. and **Strong, W.M.** (1976) Comparison of four wheat cultivars for yield and protein response to nitrogen fertilizer. *Aust. J. Agric. & Animal Husbandry* **16:** 407-410.

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تأثير مواقيت الزراعة ومستوى التسميد بالأزوت على نوعية نمو القمح في المنطقة الشرقية بالمملكة العربية السعودية

عبدالمنعم إبراهيم مصطفى و يحيى محمد مكي و حامد عثمان برهان و عثمان أحمد الطاهر

كلية العلوم الزراعية والأغذية ـ جامعة الملك فيصل ـ الأحساء ـ المملكة العربية السعودية

لقد تم زراعة عينة من القمح «أرز» تحت ثلاثة معاملات من الأزوت وأربعة مواقيت للزراعة تمتد من الأسبوع الأول من تشرين ثاني (نوفمبر) حتى الأسبوع الأخير من كانون أول (ديسمبر). وأجريت بعض اختبارات النوعية على حبوب القمح المتحصل عليها من هذه المعاملات.

أوضحت النتائج أن وزن حبة القمح قد ازداد مع الزراعة المبكرة ولكن الوزن انخفض مع زيادة معدل السماد الأزوت. أما نتائج اختبار بلشنكى فلم تظهر تغيراً واضحاً بينما ارتفعت كمية البروتين والجلوتين مع ارتفاع كمية الأزوت المستخدم معطية مؤشراً يدل على استجابة هذه العينة من القمح للأزوت. نتائج اختبار صلابة الحبوب أوضحت قلة صلابة الحبوب مع الزراعة المبكرة ويعزى ذلك إلى أثر الأمطار التي هطلت على هذه الحبوب قبل الحصاد بفترة وجيزه. كما تسببت هذه الأمطار في إصابة بعضالحبوب من النباتات المزروعة مبكراً بالفطر ولقد وضح ذلك من خلال اختبار دقيقها بوساطة الاميلوغراف حيث انخفضت قراءات الغروية العليا دالة على الإنبات الخفي والإرتفاع في نشاط إنزيم الأميليز. كما انخفضت درجة حرارة تغلظ الدقيق مع زيادة الأزوت، ولوحظ الإرتفاع في امتصاص الدقيق للماء في دقيق الحبوب المنتجة بوساطة النباتات المزروعة مبكراً وأعطيت كمية كبيرة من الأزوت. أما زمن تكون العجينة أظهر زيادة مع زيادة الأزوت المستخدم دون التأثر بموعد الزراعة. درجة ثبات العجينة كانت منخفضة وغير ثابتة الإتجاه مع المعاملات.

عند اعتبار جميع مكونات الجودة لحبوب القمح يتضح أن هذا الصنف من القمح أعطى استجابة لزيادة الأزوت مما يعطى إشارة إلى أن هذا الصنف من القمح

له قدرات تم التوصل إليها تحت ظروف الجو الحار في المنطقة الشرقية بالمملكة العربية السعودية. ويمكن التوصل إلى أن الزراعة المبكـرة لها أثـر طيب على نـوعية القمـح في حالة عدم نزول الأمطار بعد نضج الحبوب وقبل الحصاد.