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INFLUENCE OF NITROGEN FERTILIZER ON SOME QUALITY, TECHNOLOGICAL ASPECTS, PRODUCTIVITY AND AMINO ACIDS ACCUMULATION OF SUGAR BEET

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ABSTRACT

Two field trials were conducted in 1998/99 and 1999/2000 seasons in Kafr El-Sheikh governorate to study the effect of various nitrogen rates i.e.60, 80, 100, 120, 140, and 160% of the recommended rate (RR) (RR=75kg N/fed) on root quality, technological parameters and yield of sugar beet. Analysis of variance revealed that:

Increasing N dressing up to 90 kg N/ fed (20% over RR) exhibited the highest root quality, technological parameters, root and sugar yield ton / fed and minimized sugar lost to molasses. On the other hand, further N dressing decreased markedly the most studied traits.

Nitrogen dressing enhanced the content of N, P, K and Na, where a significant improvement in the concentration of those elements in samples of beet leaves and roots aged 90 and 150 days from sowing.

Accumulation of 16 amino-acids % tended to increase in beet root at harvest as nitrogen rate increased. Glutamic acid was in an abnormally high concentration under various nitrogen rates followed by Aspartic acid and the remaining acids were found in relatively low concentration.

It could be recommended, under the condition of this work, increasing N dressing up to 90 kg /fed (20% over RR) to maximize root and sugar yield

INTRODUCTION

Sugar beet (*Beta vulgaris L.*) was found to be the most suitable ancillary source of sugar to sugar cane. The total amount of sugar produced from sugar beet in 1999 season (317470* tons) represents about 25% of the total amount (1242587tons). Egyptian policy aimes to increase the amount of sugar from beet to reach 500000 tons. Not only sugar beet is grown under a wide range of climates but also the soils where the crop is cultivated vary greatly. However, they are arable soils, some have been cultivated for only a few years but many have cultivated and cropped continuously for many centuries.

Nitrogen is the most important element of those supplied to sugar beet in fertilizers. Where the element is in short supply, yield is drastically reduced and may even be halved on some soils.

Nitrogen fertilizer has a remarkable effect on the appearance of the crop, most noticeably by improving the colour and vigour of the leaf canopy. Over-use of nitrogen, decrease both sugar percentage and juice quality

(Draycott *et al*., 1974; Halvorson and Hartman, 1980; Carter and Traveller, 1981; Mahmoud *et al*., 1990; Neamat Alla, 1991; EL-Kased *et al.,* 1993; Gobara, 1993; Besheit *et al.,* 1995 and AL-Labbody, 1998).

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Not only does the excess decrease root quality but, also, it is often in a form which can be leached into ground water causing adverse effect on the environment (Draycott, 1993).

In Egypt, optimizing the use of nitrogen received much attention for optimum yield and quality through a better understanding of the crops requirement under varying conditions of soil and climate (Ahmed, 1988; EL-Kased *et al.*1993; Besheit *et al.*, 1995 and AL-Labbody, 1998).

The present paper aimed to study the effect of various Nrate (More or less than the optimum rate recorded in the literature) on the quality, technological aspects and yield of sugar beet under the environmental conditions of Kafr EL- Sheikh governorate.

MATERIALS AND METHODS

This study included six nitrogen rates 45, 60, 75 (the recommended rate), 90, 105, 120 kg N/fed which represent 60%, 80%, 120%, 140% and 160% from the RR 75kg N/fed. Two field experiments were conducted in Sakha Experimental Research Station, Kafr EL-Sheikh governorate in 1998/99 and 1999/2000 seasons. The soil was analyzed according to Chapman and Pratt (1961) and the description was given in Table (1). The experimental design was a randomized complete block with four replications. Each plot consists of 6 rows, 7m long and 50 cm apart. Spacing between hills was 20cm.

Table (1):The mechanical and chemical properties of soil.

Soil analysis	1998/99 season	1999/2000 season
Mechanical properties		
Clay	56.8	59.3
Silt	29.2	30.6
Sand	14.0	10.1
Chemical properties		
pH	8.1	7.9
EC (mmhos/cm)	1.41	1.79
Organic matter %	2.04	1.98
Available N (ppm)	36.0	38.0

A multigerm sugar beet variety Kawemira was planted by hand on August 25th and September 5th in 1998 and 1999 seasons, respectively. Nitrogen fertilizer was added in the form of Urea (46%) in two equal doses, the first was applied after thinning that has been done at 4 leaf stage to insure one plant per hill, while, the other dose was one month later. The normal practices of sugar beet cultivation were maintained at level to assure optimum production. Harvest was carried out after 7 months from sowing.

Random samples were taken from each plot after 90 and 150 days from sowing to determine some mineral constituents i.e. N, P, K, and Na in beet leaves and roots according to A.O.A.C. (1990).

At harvest, root characters, average root length, width and weight, root yield and top yield were determined from the three middle rows. Root quality (sucrose % (Pol %), K, Na, and $\propto$ Amino N) were determined using an automatic French system (Hycel), purity, sugar lost in molasses, sugar extractable %, extractability and Alkalinity coefficient were calculated as follows:

Purity % = 99.36 – [14.27 (v_1 + v_2 +v_3) / v_4] (Devillers, 1988).

Sugar lost in molasses(SM) = (v_1+v_2) 0.14 + v_3x 0.25 + 0.5 (Devillers, 1988).

Sugar extractable % = v_4 – SM- 0.6 (Dexter et al. 1967).

Extractability (sugar coefficient) = Sugar extractable % x 100 / Pol%

Alkalinity coefficient(AC) = v_1+v_2/ v_3

where :

v_1 = sodium , v_2 = potassium , v_3 = $\propto$ amino N and v_4 = Pol %

At harvest also various amino acids % in root on dry matter basis were determined according to A.O.A.C.(1990).

Analysis of variance was computed for each traits according to Steel and Torrie (1980), and treatments means were compared at the 5% level of probability.

RESULTS AND DISCUSSIONS

Root quality:

Root quality is a combination of all the chemical and physical aspects of the beet root which influence processing and hence yield of sugar and its by-product (Oldfield *et al.,* 1979). Root quality, therefore, comprises several parameters i.e. sugar contents, impurities or non sugars (such as potassium, sodium and alfa amino nitrogen) and purity (De Nie and Van den Hil, 1989). Fortunately most of root quality can be defined and easily measured. Therefore, the effect of various nitrogen rate i.e. 60,80,120,140,160% of the recommended rate (RR) on root quality are presented in Table 2.

Various N dressing significantly affected root sucrose and impurities (K, Na and α amino N) traits in 1998/99 and 1999/2000 seasons.

Nitrogen dressing at the rate of 90kg N/fed (120% of RR) exhibited the highest root sucrose % in both seasons recording 16.65% and 16.55% for 1998/99and 1999/2000 seasons, respectively. Meantime, a significant decrease in root sucrose % has been detected as N rate decreased (60% and 80% of RR) or increased (140 %and 160% of RR). In this connection Milford and Watson (1971) showed that nitrogen fertilizer increased the fraction of the assimilate entering the root that was used in growth at the expense of that stored as sugar. Thus, plants with more nitrogen had a smaller proportion of their root dry weight as sugar because more was used in growth. Data in Table (2) also cleared that the reduction in sucrose % corresponding to low N dressing was more pronounced than this of high N dressing.

Dealing with the effect of N dressing on the concentration of the three measured impurities, data in Table(2) showed a significant increase in the concentration of α amino N with the increase of N application and this trend was more pronounced in the first season while, Na concentration showed a vise versa trend in both seasons (Table 2) . Moreover, K concentration tended to increase especially under higher N dressing (140% and 160% of RR) in both seasons. Such effect on sucrose and impurities traits may be responsible for the reduction detected in purity values corresponding to higher N rate (Table 2) . The obtained results are in harmony with those of Mahmoud *et al.* (1990), Follet (1991), EL Kased *et al.* (1993), Gobara (1993), Besheit *et al.* (1995) , Neamat Alla (1997),and AL-Labbody (1998), who showed that excessive nitrogen reduced root sugar and purity percentage while impurities increased greatly.

Technological (processing) parameters:

Data in Table (2) showed that nitrogen dressing significantly affected all the technological (processing) traits i.e. sugar lost in molasses, sugar extractable % (recovery or rendment), extractability (sugar coefficient) and Alkalinity Coefficient in both seasons.

A- Sugar lost in molasses:

Data in Table (2) cleared that increasing N rate upto 105kg N/fed insignificantly affected sugar lost in molasses in 1998/99 and 1999/2000 but further application 120kg N/fed increased significantly sugar lost in molasses in both seasons.

Such effect may be due to the obvious increase in impurities especially K and α amino N as mentioned before. In this connection, Hild *et al.*(1983) and Van Geijn *et al*.(1983) reported that the significance of the amino acids as well as of potassium and sodium, has necessarily had to be taken into account in almost all calculations amid at assessing the contribution of the non- sugars to potential loss of sugars into molasses.

B-Sugar extractable percentage and extractability %:

There was a trend of increase (statistically significant) in sugar extractable and extractability percentages with the increase in N rates to reach its maximum values at 90 kg N/fed (120% of RR) recording 13.56 %, 13.82% and 81.44%, 82.02% for both traits in 1998/99 and 1999/2000 seasons, respectively. On the other hand further N application obviously decreased those traits
(Table 2).

Such effect was observed in sugar extractable and extractability have been compensated by corresponding tremendous increase in impurities and sugar lost in molasses and apparent reduction in root sucrose accompanied higher N rates as discussed before.

In this connection, Van der Beek and Huijbregts (1986) found parallel trends of reduction sugar extractability as nitrogen fertilizer increased.

The obtained results are also in harmony with those reported by EL-Kased *et al.*(1993) and Besheit *et al.*(1995).

C- Alkalinity Coefficient:

Alkalinity Coefficient (AC)or acid –base balance was determined from the major non sugars K+ Na (as alkali contributors) and the amino acid (as acid contributors) as follows:

AC = K+Na /α amino N

As reported by Oldfield *et al.,* (1979) who stated that a significant correlation between acid-base balance and the amount of soda ash had to be added during beet juice purification. Based on calculated AC as affected by N dressing in 1998/99 and 1999/2000 seasons are presented in Table (2).

Data showed that increasing nitrogen rate than the recommended rate (75kg N/fed) significantly decreased Ac traits in the first season, while , this trend was not clear in the second one except at the highest nitrogen rate (120kg N/fed) where a significant reduction in AC has been detected (Table 2).

Here with, any rate of N did not reduce AC to reach the level caused deleterious effect on beet processing or equipment as mentioned by Oldfield *et al.* (1979) and Pollach (1984) who considered that AC should not fall bellow 1.8 to prevent corrosion at the high temperatures of evaporation.

Root characters and yield of root and tops(tons/fed):

Nitrogen fertilizer significantly affected individual root characters i.e. root length, width and weight and yield of roots and tops (tons/fed) in 1998/99 and 1999/2000 seasons (Table 2).

There was a trend of gradual increase in the individual root length , width and weight as well as roots yield in tons/fed in both seasons (Table 2) as nitrogen rates increased up to 105kg N/fed (140% of RR), thereafter, further N dressing decreased (statistically insignificant) all these traits (Table 2). Such effect may be due to that large N dressing stimulates growth of new leaves develops of full leaf canopy rapidly, whereas, a gradual increase in top yield (tons/fed) has been detected as nitrogen rate increased up to 120kg N/fed in the two seasons (Table 2). Nitrogen increase root and top yield considerably needed but excess had little effect (Boyed *et al.*, 1970; Holmes, 1976; Mahmoud *et al.,* 1990; Follet, 1991; EL-Kased *et al.*, 1993; Gobara, 1993 and Besheit *et al.*, 1995).

Sugar yield (tons/fed):

Sugar yield per unit area is the main goal of sowing any sugar crop and it is the sum product of sugar extractable % and root yield per unit area. As mentioned before, even there was a decrease in root sugar content and sugar recovery accompanied large N dressing but this was compensated by the corresponding tremendous increase in the root yield and finally amounted over all increase in the sugar production per unit area (feddan).

Sugar yield increased markedly and significantly as nitrogen application increased up to 70kg N/fed in both seasons. Eventually, further N dressing up to 120kg N/f. in both seasons increased sugar production slightly but statistically insignificant (Table 2). Similar results were reviewed by Boyed *et al.* (1970), Follet (1991), EL-Kased *et al.* (1993), Gobara (1993), Besheit *et al.* (1995) and AL-Labbody, (1998).

Based on, it is recommended to increase N dressing up to 90 kg N/fed (20% over the recommended rate (75 kg N/fed.) where, the highest root quality, sugar yield/fed, adequate root yield and the lowest sugar lost to molasses have been detected (Table 2). But further N dressing increased insignificantly sugar yield due to the marked increase in root yield but the corresponding root quality and the other technological characters decreased greatly.

Minerals composition of beet leaves and root:

The effect of nitrogen fertilizer on the minerals composition i.e. N, P, K and Na of beet leaves and roots aged 90 and 150 days from sowing in 1998/99 and 1999/2000 seasons are summarized in Table (3).

Data showed that increasing N rate was accompanied with a significant improvement in N, P, K, and Na percentages in most beet leaves and roots samples aged 90 and 150 days from sowing in both seasons (Table 3).

Such effect may be due to that N dressing enhanced the uptake of other minerals which finally reflected in better growth of tops, roots and quality (Boyed *et al.* 1970; and Milford *et al.*, 1985).

In general, nitrogen element markedly increased at root samples of 150 days in both seasons as compared with those of 90 days age.In contrast P, K, and Na concentration in beet leaves and roots in both seasons were greatly decreased in samples aged 150 days (Table 3). Furthermore, root concentration of the main beet impurities i.e. N, K, and Na in samples of 90 and 150 days in both seasons were fluctuated between one- fourth to one-third those of beet leaves. Such reduction in the main beet impurities observed as plant age advanced toward maturity had great effect in minimizing loss of sugar to molasses (Oldfield et al.1979; Pollach 1984).

Amino acids:

Results of amino acids concentration (%) in beet root at harvest (on dry matter basis) in 1998/99and 1999/2000 seasons are presented in Table (4). Results in the first column in Table (4) indicated that 16 amino acids were indentificated in the dry matter in beet root at harvest time and in both seasons. The accumulation of all amino acids tended to increase as nitrogen rate increased. Similar findings were reported by Barakat *et al.* (1980) who reported that in beet root it is possible to observe a certain tendency of the amino acids content to increase slightly with age and nitrogen nutrition.

Table (4): Various amino acids concentration in sugar beet roots as affected by nitrogen fertilizer.

Amino acids	The first season						The second season					
	N rates(kg N/fed)						N rates(kg N/fed)					
	45	60	75	90	105	120	45	60	75	90	105	120
Aspartic	0.30	0.31	0.32	0.28	0.43	0.43	0.29	0.31	0.33	0.41	0.45	0.47
Threonine	0.11	0.12	0.11	0.10	0.13	0.15	0.11	0.11	0.10	0.12	0.12	0.16
Serine	0.11	0.11	0.11	0.10	0.12	0.15	0.11	0.11	0.11	0.12	0.15	0.15
Glutamic	0.33	0.34	0.46	0.30	0.73	0.71	0.38	0.37	0.46	0.43	0.73	0.74
Proline	0.11	0.12	0.12	0.11	0.17	0.18	0.12	0.12	0.12	0.12	0.17	0.17
Glycine	0.11	0.10	0.10	0.09	0.13	0.16	0.11	0.10	0.10	0.11	0.15	0.18
alanine	0.10	0.11	0.10	0.10	0.13	0.18	0.10	0.10	0.11	0.11	0.14	0.20
Cystein	0.10	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.10	0.09	0.10	0.10
Valine	0.12	0.13	0.12	0.16	0.16	0.17	0.13	0.13	0.13	0.17	0.17	0.17
Methionine	0.06	0.06	0.07	0.05	0.07	0.07	0.08	0.08	0.08	0.08	0.09	0.09
Isoleucine	0.10	0.10	0.11	0.10	0.13	0.14	0.10	0.10	0.11	0.11	0.11	0.11
Leucine	0.16	0.16	0.16	0.60	0.20	0.22	0.18	0.18	0.18	0.18	0.23	0.25
Tyrosine	0.07	0.07	0.06	0.09	0.09	0.11	0.07	0.07	0.06	0.10	0.10	0.11
Phenylalanine	0.07	0.09	0.09	0.09	0.09	0.10	0.08	0.07	0.09	0.10	0.10	0.10
Histidine	0.12	0.08	0.15	0.06	0.11	0.12	0.13	0.11	0.15	0.09	0.11	0.11
Lysine	0.13	0.15	0.15	0.14	0.21	0.18	0.17	0.16	0.16	0.20	0.20	0.20
Means	0.13	0.13	0.14	0.15	0.19	0.20	0.14	0.14	0.15	0.16	0.20	0.21

It could be, also, observed that glutamic acid % was obtained in an abnormally high concentration under various nitrogen rates followed by aspartic acid % and the remaining acids were found in relatively low concentration (Table 4).

It is worthy to mention that amino acids with glutamine being an acid contributors considered from the major non sugars which contribute to loss of sugar to molasses (Andersen and Smed, 1963). Moreover, Oldfield et al.(1979) showed that glutamic in beet was a major cause of acid production and so influence negatively various steps of beet processing .

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تــأثير التســميد النيتروجينــي علــى بعـض صـفات الجـودة والصـفات التكنولوجيــة والإنتاجية وتراكم الأحماض الأمينية في بنجر السكر

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1- قسم بحوث الفسيولوجى والكيمياء-معهد بحوث المحاصيل السكرية-مركز البحوث الزراعية

2- قسم بحوث تكنولوجيا السكر-معهد بحوث المحاصيل السكرية-مركز البحوث الزراعية

أجريت هذه الدراسة موسمي 1998/1999و1999/2000 تحت ظروف محافظـة كفر الشيخ لبحث تـأثير السماد النيتروجينـي بمعدلات أقل (60و80%) وأعلـى (120و140و160%) مـن المعدل الموصى به وهو 75كجم أزوت/فدان وذلك على صفات الجودة والثوابت التصنيعية ومحصول الجذور والسكر لبنجر السكر و قد أوضحت النتائج المتحصل عليها مايلى :

زيادة معدل إضافة النيتروجين إلـى 90كجم أزوت/فدان (20%زيـادة عن المعدل الموصـى بـه) أدت إلى تعظيم صفات الجودة و الصفات التصنيعية (السكروز % – النقاوة – السكر المستخلص % ونسبة الاستخلاص%) ومحصول الجذور و السكر بالطن /فدان كما أدت أيضـا إلـى تقليل فقد السكر فـى المولاس نتيجة لانخفاض نسبة الشوائب بينما أدت الزيادة فى معدل الأزوت المضاف بعد ذلك إلى انخفاض واضح في معظم القيم تحت الدراسة .

الانخفاض في قيم معامل القلوية (اتزان المكونات الحامضية و القلويـة) نتيجـة إضـافة الأزوت لـم يصل إلى الحد الضار أو المؤثر فى عمليات ومعدات التصنيع.

أدت إضافة الأزوت إلـى زيـادة فـي امتصـاص النيتـروجين –الفوسـفور – البوتـاسيوم – الصـوديوم حيث انعكس هذا على زيادة فى تركيزات هذه العناصر فى عينات أوراق و جذور بنجر السكر عند أعمار 90 و150 يوم من الزراعة .

زيادة التسميد الأزوتي أدت إلى زيادة فى تراكم 16 حمض أمينـي فـي جذور بنجـر السكر عند الحصاد وكان أعلى تركيز ملحوظ لحمض الجلوتاميك يليه حمض الأسبارتيك بينما بقية الأحماض أعطت قيم تركيزات منخفضة .

توصى الدراسة بزيادة معدل الأزوت المضاف إلى 90 كجم أزوت /ف (20% زيادة عن المعدل الموصى به) لتعظيم إنتاجية محصول الجذور والسكر لبنجر السكر.

Table (2): Root quality, Technological parameters, Root components and yields of sugar beet as affected by various nitrogen rates.

Seasons	N rate/ Kg/fed	Root quality				Technological parameters (%)						Root components			Root Yield T/fed	Sugar yield T/fed	
		Sucrose (pol%)	Impurities			Purity	Sugar lost in molasses	Sugar extrac -table	Sugar Coeff- ecient	Alkal. Coeff- ecient	Root Length (cm)	Root Width (cm)	Av.root Weight (gm)			
			K	Na	$\propto$AN											
First season (1998/1 999)	45	15.15	5.44	3.40	2.59	88.59	2.39	12.16	80.26	3.41	25.80	10.70	835	23.39	2.84	9.66
	60	15.75	56.10	2.96	2.95	88.46	2.51	12.46	79.11	3.07	26.00	11.06	946	26.49	3.30	11.95
	75 RR	16.45	6.06	3.38	2.88	88.67	2.54	13.31	80.91	3.28	26.10	12.00	1070	29.96	3.99	14.32
	90	16.65	5.59	2.60	3.39	89.44	2.49	13.56	81.44	2.42	26.30	12.40	1114	31.20	4.23	14.91
	105	16.05	6.07	2.23	3.44	88.92	2.52	12.93	80.56	2.41	28.30	12.80	1191	33.36	4.31	15.84
	120	16.00	6.98	2.26	3.59	87.94	2.69	12.71	79.44	2.57	28.20	12.60	1175	32.89	4.18	16.57
	L.S.D.	0.20	0.26	0.18	0.20	N.S.	0.15	0.23	0.56	0.16	0.46	0.54	43	0.89	0.36	0.50
Second season (1999/2000)	45	16.25	5.65	2.88	3.00	98.23	2.44	13.21	81.29	2.84	26.10	9.90	819	22.93	3.03	10.64
	60	16.40	6.00	2.63	2.81	98.40	2.41	13.39	81.65	3.07	26.80	10.1	859	24.05	3.22	11.30
	75 RR	16.50	6.19	2.46	2.98	98.39	2.46	13.49	81.76	2.90	27.20	10.80	946	26.48	3.57	12.92
	90	16.85	6.21	2.75	2.72	98.47	2.43	13.82	82.02	3.29	27.80	11.20	1045	29.26	4.04	14.95
	105	16.45	6.41	2.70	2.80	98.03	2.48	13.37	81.28	3.25	28.60	11.50	1143	32.00	4.28	15.17
	120	16.35	6.32	2.78	3.60	88.28	2.77	12.98	81.77	2.53	27.80	12.30	1129	31.62	4.10	15.35
	L.S.D.	0.15	0.25	0.20	0.21	N.S.	0.15	0.17	0.28	0.19	0.78	0.76	61	0.77	0.33	0.39

Table (3): Mineral composition in leaves and roots of sugar beet as affected by age and various nitrogen rates.

Age	N-rates	The first season(1998/99)								The second season (1999/2000)							
	Kg	Leaves				Root				Leaves				Root			
	N/fed	N	P	K	Na	N	P	K	Na	N	P	K	Na	N	P	K	Na
3 Months	45	2.1	0.24	2.48	1.40	1.00	0.20	1.43	0.35	2.25	0.26	2.30	1.88	1.20	0.23	1.22	0.48
	60	2.45	0.28	2.54	1.62	1.30	0.21	1.38	0.36	2.35	0.28	2.28	1.91	1.34	0.25	1.24	0.45
	75	2.45	0.28	2.55	1.67	0.90	0.20	1.33	0.42	2.40	0.28	2.34	2.15	1.51	0.24	1.33	0.47
	90	2.75	0.26	2.59	1.70	1.15	0.23	1.43	0.48	2.65	0.29	2.51	2.23	1.53	0.25	1.35	0.53
	105	3.00	0.31	2.61	1.76	1.25	0.24	1.47	0.46	2.80	0.28	2.63	2.32	1.62	0.26	1.40	0.49
	120	2.85	0.33	2.63	1.83	1.30	0.26	1.52	0.48	3.00	0.30	2.70	2.34	1.70	0.26	1.48	0.50
	L.S.D	0.20	0.04	0.09	0.11	0.21	0.03	0.08	0.04	0.07	N.S.	N.S.	0.24	0.05	N.S.	0.07	0.44
5 months	45	2.90	0.21	1.84	1.04	1.15	0.16	0.92	0.26	3.25	0.20	2.00	1.25	0.99	0.18	1.00	0.31
	60	3.20	0.23	1.86	1.00	1.20	0.16	0.74	0.26	3.10	0.22	2.05	1.33	1.23	0.20	0.99	0.33
	75	3.20	0.25	1.86	0.98	1.15	0.17	0.76	0.32	3.30	0.20	2.09	1.45	1.28	0.22	0.87	0.42
	90	3.25	0.24	1.88	0.86	1.40	0.20	0.77	0.30	3.45	0.25	2.11	1.48	1.30	0.21	0.89	0.46
	105	3.30	0.26	1.90	1.15	1.42	0.21	0.95	0.36	3.80	0.25	2.23	1.52	1.39	0.23	0.97	0.48
	120	3.55	0.28	1.90	1.14	1.65	0.21	0.89	0.39	4.00	0.33	2.26	1.55	1.44	0.23	1.11	0.48
	L.S.D	0.20	0.02	N.S.	0.16	0.09	0.03	0.06	0.04	N.S.	N.S.	N.S.	0.13	0.21	N.S.	0.14	0.08