Attempts to Improvement the Growth and Fruiting of Flame Seedless Grapevines Growing in Sandy Soil Using Slow-Release Nitrogen Fertilizers

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ABSTRACT: Flame seedless grapevines received 40 unite (N) of real nitrogen per feed over the 2020 and 2021 growing seasons. Approximately 57.1 g/N/vine of nitrogen was applied as 100% mineral fast release fertilizers (Ammonium nitrate) or as 25–50% quick release N fertilizers, specifically urea formaldehyde, urea with a phosphate coating, and urea with a sulfur coating. The purpose was to choose the optimal slow-release Nitrogen fertilizers and ratio among various Nitrogen sources. In terms of growth and yield, besides the physical and chemical traits of the berries, using nitrogen as 25% fast-release mineral nitrogen (ammonium nitrate) in addition to 75% slow-release nitrogen fertilizer (urea formaldehyde, phosphorus-loaded urea, and sulfur-loaded urea) produced the best results. With the application of nitrogen as a 100% fast-release mineral, ammonium nitrate, these features were reduced .Urea with a sulfur coating was the most effective slow-release Nitrogen fertilizer in this respect, followed shortly thereafter by urea alongside a phosphorus coating and urea-formaldehyde. It is advised to use 25% fast release nitrogen (ammonium nitrate plus 75% slow-release nitrogen fertilizer) for Flame seedless grapevines to increase yield and berry quality (sulfur-coated urea).

Keywords*:* Ammonium nitrate- urea formaldehyde phosphorus- coated urea.

INTRODUCTION

In Egypt, grapes are ranked as the fourth most important crop and the first in the world. Nowadays, grape species and their hybrids are grown. As the most popular fruit crop worldwide, grapes are made up of around 60 species; over 14,000 cultivars exist worldwide, indicating a rather high degree of variety (OIV, 2013). The majority of grape varieties that are cultivated in Egypt are European grape cultivars (Vitis vinifera L.), and they are all members of the table grape family. Due to their wonderful flavor, pleasant taste, and high nutritional content, grapes are one of the world's most well-liked and well-known fruit crops. According to (Pasingham 2004), it contains more soluble sugars, vitamins, amino acids, and other nutrients, including potassium, organic foods, anthocyanins, and antioxidants. As a result, it has a higher soluble content. Nitrogen represents one of the most important vital elements for vegetative growth and nutrition, and it also plays a crucial role in the creation of nucleic acids, proteins, and enzymes (Nijjar, 1985). Applying delayed release nitrogen fertilizers to grapevines cv cultivated in sandy soil is one of the new strategies for fertilizing grapevines that have emerged recently. These approaches were created primarily to decrease the number of replications per year. Reduce production costs, boost vine processes' usage of nitrogen, and promote denitrification (Allen, 1984; Alva, and Tucker, 1993; Scuderi et al., 1993; Wang and Alua, 1996). By using slow- release nitrogen fertilizers, plants were able to obtain more nutrients throughout the growing season at a lower cost in terms of labor and capital. Other benefits of using slow-release nitrogen fertilizers include improved seasonal diurnal variation, recognition of seeds or seeds that are damaged compared to excessive local levels of minerals, and chemical and biological in nature soil reactions that immobilize nitrogen in plant-unavailable types. (Ali-Mervet, 2000; Ibrahim- Asmaa, 2001; Kamel, 2002; Uwakiem, 2011; Abd El-Hameed, and Rabeea, 2005; Ahmed and Abada, 2012; Alam, 2014 and Ahmed et al., 2019).

The aime of the study was comparing the effects of the two types of ammonium nitrate along with slow-release nitrogen fertilizers on the growth, production, and fruit characteristics of Flame seedless grapevines grown in sandy soil.

MATERIALS AND METHODS

Forty-two vigours 12-year-old Flame seedless grapevines grafted on to Freedom grapevine rootstock. This research was carried out during two succession seasons in 2020 and 2021 .The chosen vines are grown in a private vineyard located at Kom El- Arab, Matay, west Minia district, Minia governorate, Egypt where the texture of the soil is sandy. The characteristics of the soil are shown in (Table 1). Chosen vines were pruned through the spur system, producing 72 bud (eye) per vine (12 fruiting spurs X five eyes Per spur plus six replacement spurs). Mid-December was the time for both seasons winter pruning, using Baroun supporting method. The use of well water with a salinity of 620 ppm was accompanied by a drip irrigation system. The same horticultural techniques used in the Flame seedless grapevines vineyard were applied to the 42 vines that were chosen. Soil characteristics of the used vines were analyzed according to (Wilde et al., 1985) as seen in Table (1). The study included seven different treatments, comprising ammonium nitrate (33.3% N), a fast-release nitrogen fertilizer, and three slow -release fertilizers (urea-formaldehyde (38.37% N), phosphorus-coated urea (37.11% N), and sulfur-coated urea 41.0%).

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Table (1): Analysis of the sampled soil

Constituent	Values	Constituent	Values
Sand %	81.0	pH (1: 2.5 extract)	8.08
Silt %	11.5	CaCO3	3.25
Clay %	7.5	Total N %	0.03
Texture	Sandy	Available P (ppm)	1.98
O.M.	22.0	Available K (ppm)	93.0
E.C (1: 2.5 extract) mmhos /cm/ 25 °C	1.6		

Fertilization with nitrogen was given at a rate of 40 unite (N) of real nitrogen per fed. (Montasser et al., 2003). Therefore, each vine received around 57.1 g (N) of quick or slow-release nitrogen per season.

T1- Soil addition of 100% ammonium nitrate (170.4 g NH_4NO_3 33.3% N/ vine/ season).

T2- Soil addition of 50% ammonium nitrate (85.8 g/ vine/ season) plus 50% urea formaldehyde (74.4 g/ vine/ season).

T3- Soil addition of 50% ammonium nitrate (85.8 g/ vine/ season) plus 50% phosphorus –coated urea (76.9 g/ vine/ season).

T4- Soil addition of 50% ammonium nitrate (85.8 g/ vine/ season) plus 50% sulpher –coated urea (69.6 g/ vine/ season).

T5- Soil addition of 25% ammonium nitrate (42.85 g/ vine/ season) plus 75% urea formaldehyde (111.9 g/ vine/ season).

T6- Soil addition of 25% ammonium nitrate (42.85 g/ vine/ season) plus 75% phosphorus –coated urea (115.3 g / vine/ season).

T7- Soil addition of 25% ammonium nitrate (42.85 g/ vine/ season) plus 75% sulpher –coated urea (104.4 g/vine/ season).

Two vines were used in each of the three replications of each treatment. The initial week of March represented the start of growth. The three types of slow-release nitrogen fertilizers-urea-formaldehyde (38.37%N), P-coated urea (38.33%N), and S-coated urea (41.0%N)-were placed once in circular trenches spaced 15 cm away from the main trunk and filled with soil. The fast-release nitrogen fertilizer, ammonium nitrate (33.3%N), was utilized at the following rates: 40% at the beginning of growth, 40% shortly thereafter berry setting and 20% a month subsequently. In this experiment, (RCBD) a randomized complete block design was carried out with seven treatments.

The next features were examined: -

-Shoot length (cm.) in the mid of April. -Leaf area (cm)2 (Ahmed and Morsy, 1999).

-Number of leaves/ shoots in the First week of May. -Cane thickness (cm.) in the Mid-December.

-Wood ripening coefficient was measured by dividing the length of ripened part of the shoot that had brownshed color by total length of the shoots (green color) in the ten shoots per vine (last of Oct.) according to (Bouard, 1966).

-Pruning wood weight (kg.) /vine in the Mid-December. was recorded just after carrying out pruning by weighing the removal one year old wood.

-Leaf pigments namely chlorophyll a, chlorophyll b, total chlorophylls, and total carotenoids (mg/ g F.W.) (Von-Wettstein, 1957).

-Leaf contents nutrients namely N, P, K and Mg (as %) and Zn, Fe, and Mn (as ppm) petioles of the same leaves (Summer, 1985; Chapman and Pratt, 1987 and Balo et-al., 1988).

-Yield expressed in weight (kg) and number of clusters / vines, cluster weight (g.) and dimensions (length & width in cm)

-Average berry weight (g.)

-Percentage of berry coloration %.

-Determination of the ratio of total soluble solids (TSS%) in the juice can be achieved by using a portable refractometer.

-Total acidity in the juice, expressed as a percentage with respect to tartaric acid per 100 ml of juice (A.O.A.C., 2000). Then TSS/ acid ratio was calculated.

-Percentage of juice's reducing sugars (Lane and Eynon, 1965) is explained by the (A.O.A.C., 2000).

New LSD at 5% was used for statistical comparisons of various treatment means. According to Mead et al. (1993) and Nedecor and Cochran (1980).

RESULTS

1- Aspects of vegetative growth:

Data presented in Table (2) clearly demonstrate that the application of nitrogen to Flame seedless grapevines in the form of 25% to 50% fast-release N fertilizers, in combination with 75% to 50% slow-release N fertilizers such as urea-formaldehyde, phosphorus-coated urea, and sulfur-coated urea, yields significant effects on various parameters, including main shoot length, number of leaves per shoot, leaf area, wood ripening coefficient, wood pruning weight, and cane thickness, when compared to the utilization of N as 100% N in the form of ammonium nitrate. The development of these growth features was found to have a strong association with the application of sulfur-coated urea (SCU), phosphorus-coated urea (PCU), and urea-formaldehyde (UF) in a descending order. Among the vines that were fertilized, the highest values for these growth parameters were observed in those treated with a combination of 75% sulfur-coated urea and 25% ammonium nitrate (SCU). The lowest yields were obtained by the vines fertilized by 100% ammonium nitrate. The same findings remained accurate throughout the 2020 and 2021 seasons.

2- Chemical composition of leaves:

Table (3) contains results indicating significant differences in the effects of the four slow and fast-release N fertilizers on chlorophylls a and b, total chlorophylls, total carotenoids, N, P, K, Mg, Fe, Zn, and Mn in the leaves. In comparison with the other fast-release fertilizers, ammonium nitrate, they were much higher when applying the three slow-release N fertilizers. In this regard, urea with a sulfur coating (SCU), urea with phosphorus coating (PCU), and urea with formaldehyde (UF) were the best slow-release N fertilizers. The highest values of N, P, K, Mg, Fe, Zn, and Mn leaf pigments were found on vines treated with 25% fast-release MN fertilizers (ammonium nitrate) and 75% slow-release nitrogen fertilizers (SCU). On vines that only received 100% fast release nitrogen fertilizers, the lowest leaf pigment, N, P, K, Mg, Fe, Zn, and Mn values were observed (un-slow-release nitrogen fertilizers).

3-The cluster and yield aspects:

The data presented in Table (5) clearly demonstrate that applying 25–50% quick-release nitrogen fertilizers (ammonium nitrate) towards Flame seedless grapevines along with 50–75% slow-releasing fertilizers (UF, PCU, and SCU) significantly increased yield as measured by weight and number of clusters/vine, in addition to weight, shoulder, and cluster length, in comparison to applying N as 100% fast release N fertilizer. For improving both yield and cluster weight, among the most effective slow-release nitrogen fertilizers included urea-formaldehyde (UF), phosphorus-coated urea (PCU), alongside sulfur-coated urea (SCU), in that order. The maximum yield (12.04, 14.3 kg) was obtained by the vines that received 75% sulfur-coated urea (SCU), a slow-release nitrogen fertilizer, and 25% ammonium nitrate, a fast-release nitrogen fertilizer, over both growing seasons. The lowest yields were achieved by vine crops that were fertilized with 100% fast-release ammonium nitrate. Each season showed similar characteristics. The present treatments had no impact on number of clusters/vines observed during the investigation's first season.

4- Berry physical and chemical aspects:

Data in Table (6) make it clear that applying nitrogen to Flame seedless grapevines in the form of 25 to 50% fast release nitrogen fertilizers, such as ammonium nitrate, and 75 to 50% of some slow release nitrogen fertilizers, such as (UF), (PCU), and (SCU), significantly improved the quality of the berries by increasing the percentage of berry coloration, berry weight, TSS%, reducing sugars%, and TSS/ acid ratio, as well as lowering total When the percentage of fast-release N fertilizers was decreased from 25% and the percentage of some slow release fertilizers was increased from 75%, the quality of the berries was greatly improved. SCU, PCU, and UF were the best slow-release N fertilizers in this regard, in descending order. Utilizing N via 25% ammonium nitrate and 75% sulfur-coated urea led to greater results (SCU). Berry quality of the vines that received nitrogen in the form of 100% ammonium nitrate was negatively impacted. Similar outcomes were obtained during 2020 and 2021 seasons.

DISCUSSION

Slow-release nitrogen fertilizers are superior to fast-release nitrogen fertilizers because they slowly leach from the soil, increasing efficiency. New methods for fertilizing fruit trees planted on sandy soils were also compared .Out of these, the development of slow-release nitrogen fertilizers was done primarily to decrease number of replications per year, as well as decrease production costs, increase nitrogen utilization by vines, and speed up denitrification processes (Nijjar, 1985). In addition, the useful effects of sulfur-coated urea (SCU) might be connected to its role in lowering soil pH and therefore improving the uptake of other nutrients .The positive impact of slow-release nitrogen fertilizers on supplying the trees with their nitrogen requirements over a longer time as well as the lower nitrogen loss after application of slow-release nitrogen fertilizers may be the causes of the current findings, which show that total nitrogen remained in the soil for a very long time .These results line up with those that were discovered. (Ali-Mervet, 2000; Kamel, 2002; Abd El-Hameed, and Rabeea, 2005; Ibrahim Asmaa, 2011; Uwakiem, 2011; Ahmed and Abada 2012; Rabie and Negm, 2012, Alam 2014 ;Ahmed et al., 2019 ; Silem and Salama, 2020).

CONCLUSION

Regarding flame seedless grapevines cultivated in sandy soil, it is recommended to fertilize them using 25% ammonium nitrate, a fast-releasing nitrogen fertilizer, and 75% sulfur-coated urea, a slow-release nitrogen fertilizer, under research and comparable conditions to boost growth, yield, along with berry quality.

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محاولات لتحسين نمو وإثمار كروم العنب الفليم سيدلس النامية فى التربة الرملية باستخدام الاسمدة النتروجينية بطيئة التحلل

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خلال موسمى 2020 و 2021 تم تسميد كرمات العنب الفليم سيدلس بالكمية الموصى بها من النتروجين (40 وحدة أزوت للفدان) أى ما يعادل 1. 57 جرام نتروجين صافى للكرمة وتم التسميد بالنتروجين فى صورة 100% نتروجين معدنى سريع التحلل هو نترات الامونيوم أو فى صورة 50% الى 25% نتروجين معدنى سريع التحلل مع 50% الى 75% بأسمدة نتروجينيه بطيئة التحلل هى اليوريا فورمالدهيد واليوريا المغطاة بالفوسفور واليوريا المغطاة بالكبريت وكان الهدف اختيار أفضل نسبة وأفضل سماد بطيء التحلل من مصادر النتروجين المختلفة. أدى استخدام النتروجين فى صورة 25% نتروجين معدنى سريع التحلل (نترات أمونيوم) بالإضافة الى 75% أسمدة نتروجينيه بطيئة التحلل (اليوريا فورمالدهيد واليوريا المغلفة بالفوسفور واليوريا المغلفة بالكبريت) على أفضل النتائج بخصوص النمو وكمية المحصول وكذلك الصفات الطبيعية والكيميائية للحبات وكان هناك نقص واضح فى هذه الصفات عند استخدام النتروجين بنسبة 100% نتروجين معدنى سريع التحلل نترات النشادر. وكان أفضل سماد نتروجيني بطيء التحلل فى هذا الصدد هو اليوريا المغلفة بالكبريت يليها اليوريا المغلفة بالفوسفور ثم اليوريا فورمالدهيد. لأجل تحسين كمية المحصول وجودة الحبات فى كرمات العنب الفليم سيدلس فانه ينصح باستخدام النتروجين على اساس 25% نتروجين معدنى سريع التحلل نترات أمونيوم بالإضافة الى 75% نتروجين بطيء التحلل اليوريا المغلفة بالكبريت.

الكلمات الدالة: نترات الامونيوم -اليوريا فورمالدهيد– اليوريا المغلفة بالفوسفور– اليوريا المغلفة بالكبريت

Table (2): Effect of soil application of fast and some slow release of fertilizers on some vegetative growth characteristics of Flame seedless grapevines during 2020 and 2021 seasons.

Characters / Treatments	Shoot length (cm.)		No. of leaves/ shoot (leaf)		Leaf area (cm)^2		Wood ripening coefficient		Pruning wood weight / vine (kg.)		Cane diameter (cm.)	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
T_1-100% AN	104.0	105.5	14.0	15.0	98.5	99.0	0.77	0.78	1.72	1.75	1.02	1.05
T_2- 50 % AN+ 50% UF	108.5	110.0	15.5	16.0	101.5	102.5	0.81	0.82	1.80	1.81	1.13	1.15
T_3-50 % AN+ 50% PCU	111.0	111.5	16.5	17.0	105.4	105.6	0.86	0.87	1.83	1.85	1.19	1.22
T_4-50 % AN+ 50% SCU	112.5	113.0	17.0	18.0	108.0	109.0	0.88	0.89	1.86	1.88	1.21	1.24
T_5-25 % AN+ 75% UF	113.5	114.0	18.0	19.0	110.0	110.5	0.90	0.91	1.91	1.93	1.28	1.30
T_6- T_5-25 % AN+ 75% PCU	116.0	117.0	20.0	21.0	112.5	113.0	0.94	0.95	1.98	2.00	1.35	1.38
T_7- T_5-25 % AN+ 75% SCU	119.5	121.0	22.0	23.0	113.5	114.0	0.95	0.96	2.10	2.20	1.40	1.42
New L.S.D. at 5%	0.9	1.0	1.0	1.0	1.1	1.2	0.07	0.08	0.08	0.09	0.03	0.04

Table (3): Effect of soil application of fast and some slow release of fertilizers on chlorophyll a, chlorophyll b, total chlorophylls, and total carotenoids (mg/ g f. W.), N, and P (as %) in the leaves of Flame seedless grapevines during 2020 and 2021 seasons.

Characters / Treatments	Chlorophyll a (mg/ g F.W.)		Chlorophyll b (mg/ g F.W.)		Total chlorophylls (mg/ g F.W.)		Total carotenoids (mg/ g F.W.)		Leaf N %		Leaf P %	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
T_1-100% AN	2.55	2.60	1.11	1.13	3.66	3.73	1.22	1.23	1.60	1.62	0.15	0.17
T_2- 50 % AN+ 50% UF	2.70	2.72	1.16	1.18	3.86	3.90	1.28	1.30	1.72	1.75	0.20	0.21
T_3-50 % AN+ 50% PCU	2.78	2.80	1.19	1.20	3.97	4.00	1.33	1.35	1.77	1.79	0.24	0.25
T_4-50 % AN+ 50% SCU	2.85	2.90	1.22	1.24	4.07	4.14	1.38	1.41	1.82	1.83	0.27	0.28
T_5-25 % AN+ 75% UF	2.90	2.95	1.26	1.28	4.16	4.23	1.44	1.46	1.90	1.91	0.32	0.33
T_6- T_5-25 % AN+ 75% PCU	3.00	3.05	1.31	1.33	4.31	4.38	1.50	1.52	1.95	1.96	0.37	0.36
T_7- T_5-25 % AN+ 75% SCU	3.10	3.15	1.37	1.40	4.47	4.55	1.55	1.58	1.98	1.98	0.40	0.42
New L.S.D. at 5%	0.06	0.07	0.03	0.04	0.09	0.11	0.04	0.05	0.07	0.08	0.03	0.03

AN : Ammonium nitrate **- PCU :** phosphorus – coated Urea **-UF :** Urea formaldehyde **-SCU :** Sulphur- coated Urea

Table (4): Effect of soil application of fast and some slow release of fertilizers on the leaf content of K and Mg (as %) and Fe, Zn, and Mn (as ppm) of Flame seedless grapevines during 2020 and 2021 seasons.

Characters / Treatments	Leaf K %		Leaf Mg %		Leaf Fe (ppm)		Leaf Zn (ppm)		Leaf Mn (ppm)	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
T_1-100% AN	1.16	1.18	0.52	0.55	50.0	51.2	41.5	42.0	46.5	47.2
T_2- 50 % AN+ 50% UF	1.23	1.25	0.58	0.59	55.5	56.4	44.0	44.5	51.0	52.0
T_3-50 % AN+ 50% PCU	1.27	1.29	0.63	0.65	58.2	58.8	46.5	47.0	53.5	54.4
T_4-50 % AN+ 50% SCU	1.31	1.33	0.65	0.68	61.5	62.5	48.2	48.9	55.8	56.0
T_5-25 % AN+ 75% UF	1.41	1.44	0.68	0.69	66.8	66.9	51.5	51.8	61.2	61.8
T_6- T_5-25 % AN+ 75% PCU	1.48	1.49	0.70	0.71	70.2	71.5	52.9	53.0	63.0	63.5
T_7- T_5-25 % AN+ 75% SCU	1.55	1.58	0.72	0.73	72.5	73.5	54.0	55.0	65.2	66.0
New L.S.D. at 5%	0.05	0.06	0.02	0.02	1.7	1.9	1.4	1.5	1.9	2.0

Table (5): Effect of soil application of fast and some slow release of fertilizers on yield expressed in weight (kg.) and a number of cluster/vine as well as weight and dimensions cluster of Flame seedless grapevines during 2020 and 2021 seasons.

Characters / Treatments	No. of cluster / vine		Yield/ vine (kg.)		Cluster weight (g.)		Cluster length (cm.)		Cluster width (cm.)	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
T_1-100% AN	26.0	27.0	9.49	9.88	365.0	366.0	19.5	19.8	11.2	11.2
T_2- 50 % AN+ 50% UF	27.0	29.0	10.31	11.17	382.0	385.0	21.0	22.0	13.0	13.2
T_3-50 % AN+ 50% PCU	27.0	30.0	10.53	11.85	390.0	395.0	23.5	24.0	14.5	14.8
T_4-50 % AN+ 50% SCU	27.0	30.0	10.67	12.00	395.0	400.0	26.0	26.5	15.6	16.0
T_5-25 % AN+ 75% UF	27.0	31.0	11.07	13.02	410.0	420.0	26.8	27.0	16.5	17.0
T_6- T_5-25 % AN+ 75% PCU	27.0	32.0	11.34	13.60	420.0	425.0	28.9	29.0	17.8	18.0
T_7- T_5-25 % AN+ 75% SCU	28.0	33.0	12.04	14.36	430.0	435.0	29.5	30.0	18.5	18.8
New L.S.D. at 5%	NS	1.0	0.6	0.8	8.8	9.2	0.8	0.9	0.3	0.4

AN : Ammonium nitrate **- PCU :** phosphorus – coated Urea **-UF :** Urea formaldehyde **-SCU :** Sulphur- coated Urea

Table (6): Effect of soil application of fast and some slow release of fertilizers on the percentage of berries coloration, berry weight as well as some chemical parameters of the berries of Flame seedless grapevines during 2020 and 2021 seasons.

Characters / Treatments	Berry coloration %		Berry weight (g.)		TSS%		Total acidity %		TSS/ acid ratio		Reducing sugars %	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
T_1-100% AN	87.5	88.0	3.15	3.20	17.8	18.0	0.690	0.685	25.7	26.2	15.6	15.8
T_2- 50 % AN+ 50% UF	89.2	90.0	3.30	3.35	18.5	18.8	0.640	0.630	28.9	29.8	16.4	16.7
T_3-50 % AN+ 50% PCU	92.0	92.8	3.50	3.55	19.4	19.6	0.620	0.610	31.3	32.1	17.3	17.5
T_4-50 % AN+ 50% SCU	93.5	94.2	3.60	3.65	19.8	20.0	0.610	0.590	32.4	33.8	17.7	17.6
T_5-25 % AN+ 75% UF	96.0	96.5	3.75	3.78	20.5	20.6	0.580	0.575	35.3	35.8	18.4	18.6
T_6- T_5-25 % AN+ 75% PCU	96.8	97.0	3.80	3.82	20.8	21.0	0.570	0.565	36.5	37.2	18.7	19.0
T_7- T_5-25 % AN+ 75% SCU	97.5	98.5	3.85	3.90	21.0	21.2	0.560	0.550	37.5	38.5	18.9	19.1
New L.S.D. at 5%	0.7	0.8	0.03	0.04	0.4	0.5	0.015	0.013	1.2	1.3	0.3	0.4

AN : Ammonium nitrate **- PCU :** phosphorus – coated Urea **-UF :** Urea formaldehyde **-SCU :** Sulphur- coated Urea