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# DEVELOPED APPROACH FOR GRAPEVINE FERTILIZATION

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## ABSTRACT

Grapevine fertilization is one of the most sensitive practices, particularly interested in management package. Three years study (2004, 2005 & 2006) has been conducted in a private vineyard located at El-Khatatba region, Menofia Governorate to investigate the effect of ureaform (UF) as a slow release nitrogen fertilizer and ammonium nitrate (AN) as an ordinary one with or without application of farmyard manure (FYM) on yield and quality parameters of Thompson seedless grapes (Vitis Vinifera L.).

Results indicate that no significant effects for the different treatments on the morphological characters have been observed except that of leaf area which has shown clear response to both UF treatment rates and FYM application. Also, it is observed that such character values were superior in the 3rd year to those of 2nd one. All treatments have given good quality grape yield. However, it is observed some inferiority concerning total sugar and total soluble solids as well as high acidity in condition of available nitrogen glut expected and due to high nitrogen rates or FYM application.

In 2nd year, it is observed positive effect for each FYM and UF treatment on cluster weight, yield/ vine and yield/ fed. The UF rate of 96 kg N/fed without FYM and 48 kg N/ fed with adding FYM have been the most superior. In the 3rd year, No effective for FYM application on the yield or their components has been marked, yet on the contrary, the nitrogen treatments without FYM application have given the most yield, it is also observed that the treatments tagged (+) have given yield more than those tagged (*) regardless fertilizer type or rate.

Concerning the economic evaluation, net return and investment factor (IF) of UF treatments has been superior to those of AN treatment in case of no adding FYM, the contrary has been true in case of FYM application. In the 2nd year, it is illustrated that the optimum rates to fulfill the maximum profitability have been 96 kg N/ fed. without FYM application and 48 kg N/ fed. with FYM application. In the 3rd year, and because of its yield has been more than that of 2nd one, its net return has been so much comparing with those of 2nd one.

Generally, the treatments have not received N-fertilizer in the 3rd year has been the most profitability although its net return has been less than those received N-fertilizer. This means that the highest yield does not mean the highest profitability. However, still the rate 96 kg N/ fed. without FYM application and 48 kg N/ fed. with FYM application have been the most profitability.

**Keywords:** grapevine, slow release nitrogen fertilizer, ureaform, ammonium nitrate, farmyard manure, net return

## INTRODUCTION

Generally, fertilization of vine yards is one of the most sensitive services, particularly interested in programs to control nitrogen fertilization. Where the consequent excessive addition of nitrogenous fertilizers increased succulent growth, delayed maturity of fruits as well as increased sensitivity of vine yards of fungal diseases and exposure to damage winter cold. On the other hand, reduction of nitrogen fertilization and suffering of nitrogen deficiency leads to a decline in buds fertility and week growth vegetation in addition to the small size of grapes and lack of crop.

The effects of fertilization or fertilizer type or amount on plant health and quality were reported through long-term experiment. One of them from 1944 to 1966 illustrated that ammonium sulphate application resulted in sever reduction of vine growth and yield (Tulloch and Harris, 1970). In other long term experiment (11 years), Conradie and Saayman (1989a) reported that nitrogen fertilization increased yield and shoot growth. Also, Conradie and Saayman (1989b) revealed that no consistent effect of N-fertilization on either grape or wine quality could be detected, but during one season the occurrence of bunch rot was enhanced by the high N-application. In the same respect, Spayd and Morris (1979) reported that N-fertilizer levels (152- 228 kg N/ha) as $NH_4NO_3$ had no effect on yield, pruning weight, soluble solids and absorbance, but acidity was reduced at the high nitrogen level.

Chang and Kiewer (1991) reported that the growth of vines was substantially reduced in $NH_3$-treated plants. As for urea application, Goldspink and Gordan (1991) applied single and split application of urea at bud burst, fruit set and post harvest, they reported that the highest grape yield were obtained when N was applied at bud burst whereas post harvest application showed to be inefficient. Shaker (2001) showed that mono ammonium phosphate resulted in a higher yield with better fruit quality.

Roberts and Ahmedullah (1991) reported in their study regarding the effect of increasing ordinary nitrogen fertilizers supply on $NO_3^-$ concentration in grape petioles, that $NO_3^-$ level in the petioles increased with increasing N-rate. It seems that the N-fertilization of vine is debatable issue, particularly if the $NO_3^-$ pollution either in plants or in soils was taken into consideration, where it is well known that the $NO_3^-$ pollution potentiality of natural water sources was caused by leaching N-fertilizers from soils. To prevent or alleviate severity of such pollution, N-fertilization management should be attentively arranged synchronizing the rest of the agricultural elements to obtain cleaned agricultural products. There are now available slow release formulations of N-fertilizers which reduce the possibility of injury from over fertilization or fertilization too close to the root system as well as prevention both plant and water sources from $NO_3^-$ pollution.

Concerning works performed for slow release nitrogen fertilizers (SRNFs) application to fertilize vine yards. Colugnati *et al.* (1997) compared isobutylidene diurea (IBDU) with dicyandiamide (DCD) application at different treatment dates in grape vine, they reported that the post harvest nitrogen supply positively influenced total buds, sprouting buds and cluster number and also such formulation of fertilizers achieved more balanced plants. Springett (2001) showed that the application of SRNF to grape improved substantially crop yield and diminished a frost damage of buds, enhancement of berry production and resistance to chill and disease damage. Ismail (2000) revealed that sulphur coated urea, phosphours coated urea and ureaformaldehyde in descending order were very effective in improving the quality and yield of Flame seedless grape vines compared to urea fertilizer. Colepietra and Alexander (2006) found that application of methyleneurea resulted in increasing bunch weight and delayed maturity as evidenced by the lowest sugar content. Also, they indicated that such fertilizer led to retard the maturation until the end of the commercialization period (November-December).

As for SRNFs per se, in general, they are techniques to minimize the amount of N-released from fertilizer and in turn minimize nitrate pollution either in plants or water sources and also ammonia and nitrous oxide gas emissions and consequently, minimizing nitrogen loss which resulted in improving soil fertility and yield quality as well as enhancing the efficiency of nitrogen application and economic return.

Slow release nitrogen fertilizer (SRNF) used in this paper is the ureaformaldehyde, and so called, shortly, ureaform (UF). UF-fertilizer composition was prepared by the reaction of urea and formaldehyde comprising polymeric nitrogen in the form of methyleneurea polymers of varying chain length. The majority of the polymeric nitrogen consists of short chain polymers selected from the group consisting of methylene diurea, dimethylene triurea and mixtures (Abbady et al., 1991). This type of fertilizers provides nitrogen element over a period of time (usually 9 to 12 month) or two growth seasons. Once applied at beginning the fertilization period.

This study has undertaken to investigate optimum rate of ureaform (UF) as a SRNF and best practice for obtaining optimum grapevine growth, quality and yield as well as maximum economic return.

## MATERIALS AND METHODS

The experiment has been conducted during three successive years (2004, 2005 and 2006) on ten years old, own-rooted Thompson seedless (*Vitis Vinifera L.*) grapevines grown in a well drained loamy sand soil of private vineyard located at El-Khatatba region, Menofia Governorate. The grapevines were spaced at 1.5 x 3.0 meters apart. The vines were trained to the modified cane training and supported by telephone trellis system. The first season (2004) has been considered as an introductory season to overcome the residual effect of the previously used fertilization during the preceding years, so its data has been excluded. The soil analysis (Wilde et al., 1985) of this vineyard is shown in Table (1).

**Table (1). Some soil properties of the studied vineyard soil.**

| Property | pH | EC (dS/m) | Ca | Mg | Na | K | $CO_3$ | $HCO_3$ | Cl | $SO_4$ | O.M.% | Sand % | Silt % | Clay % | Texture class | $CaCO_3$ % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Value | 8.11 | 2.02 | 2.84 | 4.21 | 14.34 | 0.76 | 0.00 | 1.30 | 14.26 | 6.59 | 0.80 | 84.53 | 8.67 | 6.80 | loamy sand | 3.47 |

A split plot design has been used in this experiment

(a) main plots have been FYM in two treatments; 0.0 and 30 m3/ fed

(b) subplots have come as follow:

1- Control (not received any fertilizer)

2- Ammonium nitrate, 80 kg N/ fed ≈ 250 g AN / vine/ year (AN)

3- Ureaform, 48 kg N/ fed ≈ 130 g UF/ vine/ year (UF1)

4- Ureaform, 64 kg N/ fed ≈ 170 g UF/ vine/ year (UF2)
5- Ureaform, 80 kg N/ fed ≈ 210 g UF/ vine/ year (UF3)
6- Ureaform, 96 kg N/ fed ≈ 250 g UF/ vine/ year (UF4)

Every treatment has been replicated three times, 4 vine per each (144 vines). In third year, the subplots again have split into 2 subsubplot (c ), one of them has received the same amount and form of nitrogen fertilizer as was in previous year (tagged +). The other one has dispatched nitrogen fertilizer to study the residual effect of previous application in year 2005 (tagged *).

FYM has been added in a cavity (40x40x40 cm) beside the grapevines before the begging of growing season (2005). The ammonium nitrate (33.3 N %) was added side dress in three doses, the first one (80g/ vine) at 35% bud burst, the second one (120g/ vine) after blooming to veraison stage and the last one (50g/ vine) after harvesting grape yield. The ureaform (40 % N, 60% activity index) manufactured by Abbady *et al.* (1991) has been added side dress in one dose at the beginning of yield fertilization season (2005).

The chosen Thompson seedless grapevines have almost had the same vigor. Five canes of 14 buds each and approximately four renewal spurs, two buds each, have been retained on each vine at winter pruning in the middle of January in 2005 &2006 years (according to Fawzi *et al.,* 1984). The vines were drip irrigated and received known agricultural practices which already applied in the vineyard.

The tested treatments were evaluated through the following parameters:-

1- Fruit quality:- five clusters from the yield of each vine were taken randomly and the following determination were carried out:-
   - Average berry weight and berry size
   - Total soluble solids percentage (TSS %)
   - Total acidity (%) in juice as g tartaric acid/ 100 g juice (A.O.A.C., 1985)
   - TSS/ acidity ratio
   - Berry length and width as well as berry shape index (length/ width)

2- Leaf area and NPK contents:- samples of twenty leaves opposite to the basal clusters were taken and the average leaf area was estimated according to Jain and Misra (1966) and percentage of N, P and K on dry weight basis were determined in the petioles of these leaves according to Wilde *et al.* (1985).

3- Yield and cluster weight:- the harvesting took place on mid June, cluster number per vine and the yield per vine were recorded, then the average cluster weight was calculated.

The obtained data were statistically analyzed according to Snedecor and Cochran (1980).

## RESULTS AND DISCUSSIONS

The studied points, here, have been limiting parameters for quality, percentage concentration of N, P & K and yield & yield components of grape at two successive years to determine the main and residual effect of SRNF as well as calculation of economic return has been included.

**1-Parameters of quality**

**a) Morphological characters**

Data given in Table (2) show the relation of different treatments either in presence of FYM or not with some morphological characters. In year 2005, no significant effect for FYM application has been shown on the most studied characters (weight, size, length, width and shape index of berry) but there has been clear significance as regarding to leaf area since it has been markedly increased in case of adding FYM comparing with that of no adding it. It is well known that the useful effect of organic matter on physical and chemical properties of soil which has been certainly conditioned suitable environment for plant growth and nutrients uptake. Such result has been in harmony with those of Nijjar (1985) and Ahmed *et al.* (2000).

As for the effect of different fertilization treatments, also no clear significant effect has been noticed on different studied characters except on the leaf area since there has been gradually increasing for such area along with the increasing nitrogenous rates of UF. It is worthy mentioned that the effect of UF treatments (on average) on such character has been obviously superior to that of ammonium nitrate (AN) treatment as well as it has had slight increasing as regarding to other characters. This positive effect of UF may be due to the regular release of its nitrogen which would meet, to rational extent, the nutritive need of plant from nitrogen. Moreover, Alice Wise (2002) added that SRNF promotes root growth to help plant recover from summer stress. Also, helps prepare plant for winter.

In year 2006, it is observed similar trend to that of year 2005 concerning the different characters of morphology has been prevailed; each of FYM and different fertilization treatments have been had significant effect only on leaf area. Also, final both split treatments (+, *) have had significant effect only on leaf area; regardless of the rate of treatments, the treatment tagged (+) has had superiority to that of tagged (*) either in existence of FYM or not.

In general, there has been slight superiority for the investigated characters values of year 2006 to their corresponding in 2005. Such effect would support the concept of SRNF application and show its continuation from year to another.

Table (2). Effect of FYM application, slow and fast release nitrogen fertilizers on some morphological parameters of Thompson seedless grapevine through two succssive years.

| | Year 2005 | | | | | | | Year 2006 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Treat. (B) | Leaf area ($cm^2$) | Av. Berry wieght (g) | Av. Berry size (cm3) | Av. Berry length (cm) | Av. Berry width (cm) | Berry shape index | Treat. (C ) | Leaf area ($cm^2$) | Av. Berry wieght (g) | Av. Berry size (cm3) | Av. Berry length (cm) | Av. Berry width (cm) | Berry shape index |
| Without farmyard manure (A) | Control | 153.00 | 1.23 | 1.19 | 1.45 | 1.27 | 1.14 | Cont. | 155 | 2.13 | 1.59 | 1.42 | 1.11 | 1.23 |
| | | | | | | | | Cont. | 156.00 | 2.16 | 1.68 | 1.44 | 1.13 | 1.27 |
| | AN | 160.00 | 1.62 | 1.60 | 1.70 | 1.35 | 1.25 | AN+ | 180.00 | 2.04 | 2.00 | 1.69 | 1.40 | 1.20 |
| | | | | | | | | AN* | 175.00 | 2.24 | 2.15 | 1.61 | 1.23 | 1.30 |
| | UF1 | 152.00 | 1.91 | 1.80 | 1.71 | 1.40 | 1.21 | UF1+ | 185.00 | 2.32 | 2.27 | 1.53 | 1.32 | 1.15 |
| | | | | | | | | UF1* | 170.00 | 2.66 | 2.60 | 1.65 | 1.40 | 1.17 |
| | UF2 | 170.00 | 2.15 | 1.90 | 1.69 | 1.40 | 1.20 | UF2+ | 212.00 | 1.80 | 1.50 | 1.51 | 1.31 | 1.15 |
| | | | | | | | | UF2* | 200.00 | 2.42 | 2.36 | 1.43 | 1.40 | 1.02 |
| | UF3 | 180.00 | 2.18 | 2.00 | 1.80 | 1.40 | 1.28 | UF3+ | 205.00 | 2.50 | 2.47 | 1.63 | 1.31 | 1.24 |
| | | | | | | | | UF3* | 187.00 | 1.90 | 1.62 | 1.53 | 1.30 | 1.17 |
| | UF4 | 190.00 | 2.11 | 2.00 | 1.90 | 1.50 | 1.26 | UF4+ | 210.00 | 2.26 | 2.16 | 1.72 | 1.34 | 1.28 |
| | | | | | | | | UF4* | 207.00 | 1.94 | 1.90 | 1.63 | 1.42 | 1.14 |
| | mean | 167.50 | 1.87 | 1.75 | 1.71 | 1.39 | 1.22 | mean+ | 191.17 | 2.18 | 2.00 | 1.58 | 1.30 | 1.21 |
| | | | | | | | | mean* | 182.50 | 2.22 | 2.05 | 1.55 | 1.31 | 1.18 |
| With farmyard manure | Control | 156.00 | 1.27 | 1.18 | 1.50 | 1.34 | 1.11 | Cont. | 160.00 | 2.30 | 1.75 | 1.45 | 1.20 | 1.20 |
| | | | | | | | | Cont. | 159.00 | 2.25 | 1.71 | 1.42 | 1.15 | 1.18 |
| | AN | 178.00 | 1.30 | 1.26 | 1.70 | 1.33 | 1.27 | AN+ | 175.00 | 2.30 | 2.10 | 1.56 | 1.40 | 1.11 |
| | | | | | | | | AN* | 162.00 | 2.18 | 2.15 | 1.61 | 1.39 | 1.15 |
| | UF1 | 154.00 | 2.20 | 2.20 | 1.90 | 1.45 | 1.31 | UF1+ | 177.00 | 1.70 | 1.70 | 1.82 | 1.35 | 1.34 |
| | | | | | | | | UF1* | 168.00 | 2.34 | 2.00 | 1.62 | 1.36 | 1.19 |
| | UF2 | 191.00 | 2.27 | 2.10 | 1.80 | 1.55 | 1.16 | UF2+ | 198.00 | 2.18 | 2.14 | 1.40 | 1.31 | 1.06 |
| | | | | | | | | UF2* | 193.00 | 1.46 | 1.35 | 1.42 | 1.40 | 1.01 |
| | UF3 | 201.00 | 1.90 | 1.70 | 1.65 | 1.39 | 1.18 | UF3+ | 195.00 | 2.48 | 2.45 | 1.90 | 1.51 | 1.25 |
| | | | | | | | | UF3* | 180.00 | 2.48 | 2.45 | 1.64 | 1.40 | 1.17 |
| | UF4 | 220.00 | 2.34 | 2.16 | 1.90 | 1.50 | 1.26 | UF4+ | 203.00 | 2.00 | 1.95 | 1.70 | 1.38 | 1.23 |
| | | | | | | | | UF4* | 198.00 | 1.82 | 1.79 | 1.69 | 1.30 | 1.30 |
| | mean | 183.33 | 1.88 | 1.77 | 1.74 | 1.43 | 1.22 | mean+ | 184.67 | 2.16 | 2.02 | 1.64 | 1.36 | 1.20 |
| | | | | | | | | mean* | 176.67 | 2.09 | 1.91 | 1.57 | 1.33 | 1.17 |
| LSD 5% | A | 0.88 | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | LSD A | 0.31 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 |
| | B | 0.48 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | B | 0.44 | 0.01 | 0.01 | 0.00 | 0.01 | 0.00 |
| | A*B | 0.68 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | C | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | | | | | | A*B | 0.63 | 0.01 | 0.01 | 0.00 | 0.01 | 0.00 |
| | | | | | | | | A*C | 0.10 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 |
| | | | | | | | | B*C | 0.17 | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 |
| | | | | | | | | A*B*C | 0.24 | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 |

AN= ammonium nitrate UF= ureaformaldhid + the experimental unit received N fertilizer in second year
* the experimental unit received N fertilizer in first year only

## B) Chemical composition and properties

In general, all treatments (Table 3) either on the 2nd or 3rd year have produced grape yield of acceptable quality because their TSS % being frequently given more than 15 (Spayd and Morris, 1979). No significant effect has been observed for FYM application on any of chemical composition or chemical properties for the yield in the 2nd or 3rd year. Uf treatments (on average) at 2nd year have given total sugar % and total acidity values approaching to those of AN treatment either in presence of FYM or not.

**Table (3). Effect of FYM application, slow and fast release nitrogen fertilizers on chemical composition and properties of Thompson seedless grapevine through two succssive years.**

| | Year 2005 | | | | | | | | Year 2006 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Treat. (B) | Total sugar % | TSS % | Total acisity % | TSS/ acidity ratio | Macronutrients % in leaf N | P | K | Treat. (C ) | Total sugar % | TSS % | Total acisity % | TSS/ acidity ratio | Macronutrients % in leaf N | P | K |
| Without farmyard manure (A) | Control | 20.60 | 17.00 | 0.88 | 19.32 | 1.03 | 0.17 | 0.85 | Cont. | 19.80 | 21.00 | 0.89 | 23.60 | 0.94 | 0.13 | 0.91 |
| | | | | | | | | | Cont. | 19.72 | 21.1 | 0.83 | 23.54 | 0.91 | 0.11 | 0.84 |
| | AN | 24.00 | 18.50 | 0.70 | 26.42 | 1.37 | 0.29 | 1.01 | AN+ | 19.80 | 23.00 | 0.75 | 30.66 | 1.35 | 0.21 | 1.21 |
| | | | | | | | | | AN* | 20.10 | 18.10 | 0.71 | 25.49 | 1.38 | 0.27 | 1.31 |
| | UF1 | 24.00 | 21.00 | 0.64 | 32.81 | 1.05 | 0.25 | 1.10 | UF1+ | 23.30 | 17.00 | 0.69 | 24.63 | 1.18 | 0.21 | 1.17 |
| | | | | | | | | | UF1* | 22.00 | 17.00 | 0.87 | 19.54 | 1.17 | 0.20 | 1.02 |
| | UF2 | 23.90 | 18.30 | 0.65 | 28.15 | 1.24 | 0.30 | 1.20 | UF2+ | 24.10 | 18.00 | 0.75 | 24.00 | 1.18 | 0.24 | 1.29 |
| | | | | | | | | | UF2* | 20.30 | 20.00 | 0.66 | 30.76 | 1.31 | 0.26 | 1.18 |
| | UF3 | 21.00 | 18.00 | 0.90 | 20.00 | 1.31 | 0.31 | 1.10 | UF3+ | 21.00 | 22.00 | 0.80 | 27.50 | 1.32 | 0.29 | 1.30 |
| | | | | | | | | | UF3* | 22.30 | 22.00 | 0.91 | 24.17 | 1.29 | 0.24 | 1.30 |
| | UF4 | 22.50 | 22.00 | 0.87 | 25.28 | 2.10 | 0.31 | 1.30 | UF4+ | 22.00 | 17.90 | 0.86 | 20.81 | 1.29 | 0.30 | 1.28 |
| | | | | | | | | | UF4* | 23.10 | 18.00 | 0.79 | 22.78 | 1.31 | 0.31 | 1.24 |
| | mean | 22.67 | 19.13 | 0.77 | 25.33 | 1.35 | 0.27 | 1.09 | mean+ | 21.67 | 19.82 | 0.79 | 25.20 | 1.21 | 0.23 | 1.19 |
| | | | | | | | | | mean* | 21.25 | 19.37 | 0.80 | 24.38 | 1.23 | 0.23 | 1.15 |
| With farmyard manure | Control | 22.00 | 17.10 | 0.85 | 20.11 | 1.05 | 0.18 | 0.90 | Cont. | 21.00 | 22.00 | 0.85 | 25.88 | 0.98 | 0.15 | 0.98 |
| | | | | | | | | | Cont. | 21.05 | 22.03 | 0.82 | 25.46 | 0.93 | 0.14 | 0.93 |
| | AN | 21.10 | 24.00 | 0.62 | 38.70 | 1.30 | 0.19 | 1.31 | AN+ | 20.10 | 23.00 | 0.81 | 28.39 | 1.31 | 0.32 | 1.29 |
| | | | | | | | | | AN* | 21.90 | 23.00 | 0.90 | 25.55 | 1.21 | 0.34 | 1.32 |
| | UF1 | 24.40 | 17.00 | 0.78 | 21.79 | 1.21 | 0.21 | 1.20 | UF1+ | 21.00 | 19.00 | 0.65 | 29.23 | 1.19 | 0.23 | 1.29 |
| | | | | | | | | | UF1* | 21.90 | 19.00 | 0.65 | 29.23 | 1.23 | 0.20 | 1.41 |
| | UF2 | 21.60 | 19.30 | 0.67 | 28.80 | 1.18 | 0.21 | 1.00 | UF2+ | 21.90 | 20.00 | 0.90 | 22.22 | 1.31 | 0.25 | 1.32 |
| | | | | | | | | | UF2* | 18.90 | 16.20 | 0.75 | 21.60 | 1.24 | 0.25 | 1.24 |
| | UF3 | 20.20 | 19.80 | 0.80 | 24.75 | 1.25 | 0.23 | 1.00 | UF3+ | 21.30 | 18.00 | 0.75 | 24.00 | 1.39 | 0.30 | 1.25 |
| | | | | | | | | | UF3* | 21.30 | 23.00 | 0.74 | 31.08 | 1.23 | 0.29 | 1.34 |
| | UF4 | 20.30 | 17.20 | 0.68 | 25.29 | 1.30 | 0.29 | 1.20 | UF4+ | 23.20 | 18.10 | 0.79 | 22.91 | 1.31 | 0.31 | 1.42 |
| | | | | | | | | | UF4* | 24.10 | 21.00 | 0.64 | 32.80 | 1.32 | 0.32 | 1.32 |
| | mean | 21.60 | 19.07 | 0.73 | 26.57 | 1.22 | 0.22 | 1.10 | mean+ | 21.42 | 20.02 | 0.79 | 25.44 | 1.25 | 0.26 | 1.26 |
| | | | | | | | | | mean* | 21.53 | 20.71 | 0.75 | 27.62 | 1.19 | 0.26 | 1.26 |
| LSD 5% | A | 0.05 | 0.00 | 0.00 | 0.06 | 0.01 | 0.01 | 0.00 | LSD A | 0.01 | 0.04 | 0.00 | 0.08 | 0.00 | 0.00 | 0.01 |
| | B | 0.04 | 0.06 | 0.01 | 0.14 | 0.01 | 0.01 | 0.01 | B | 0.04 | 0.05 | 0.00 | 0.06 | 0.01 | 0.01 | 0.00 |
| | A*B | 0.05 | 0.08 | 0.01 | 0.20 | 0.01 | 0.01 | 0.01 | C | 0.02 | 0.02 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 |
| | | | | | | | | | A*B | 0.06 | 0.06 | 0.01 | 0.09 | 0.01 | 0.01 | 0.01 |
| | | | | | | | | | A*C | 0.02 | 0.02 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 |
| | | | | | | | | | B*C | 0.04 | 0.04 | 0.00 | 0.08 | 0.00 | 0.00 | 0.01 |
| | | | | | | | | | A*B*C | 0.06 | 0.06 | 0.01 | 0.11 | 0.01 | 0.01 | 0.01 |

**AN= ammonium nitrate UF= ureaformaldhid + the experimental unit received N fertilizer in second year**
*** the experimental unit received N fertilizer in first year only**

Also, they have given total soluble solids (TSS %) values more than that of AN one in case of no adding FYM and less in case of adding it. As for macronutrient N, P and K no significant effect has been observed among the different treatments.

In the 3rd year, the effect of FYM on the studied parameters has been taken the same above mentioned trend. UF treatments (on average) have given total sugar values more than that of AN one in case of no adding FYM and less in case of adding it as well as they have given TSS% values less than that of AN treatment either in presence of FYM or not. Similarity for each acidity values or macronutrient (N, P and K) has been recorded for different treatments either in case of adding FYM or not.

It is observed marked superiority for the treatments tagged (*) to treatments tagged (+) in the matter of total sugar and TSS % with reduction of total acidity %. Mostly, it is frequented that with increasing the chance of available nitrogen presence, the total sugar and TSS values have reduced while total acidity has increased. These results have been in agreement with those of Ismail (2000).

**2- Yield and yield components**

Data given in Table (4) reveal that the obtained yield of control has been as a result of nitrogen fertilization of past year (2004). In general, there have been clear variation in yield and its component values as affected by slow (UF) and fast (AN) release fertilizers, they have been whether the same, more or less, according to the application of FYM or not, and used different rates of each treatments. In year 2005, regardless of fertilizer treatments, FYM application has had slight effect on the pruning weight and positive effect on the cluster weight as well as yield/ vine and yield/ fed.

The effect of different applied rates of UF comparing to the recommended rate of AN is recorded in Table (4). No significant effect has been observed on pruning weight values due to different treatments. As for the other characters of yield components, UF4 has given the maximum value for cluster weight in case of no adding FYM and minimum one in case of adding it. Obvious superiority for yield/ vine and yield / fed values has been recorded for UF4 treatment in case of no adding FYM. The quite contrary has occurred in case of adding it, since this treatment has given so inferior value for such components. This effect may be attributed to that the microorganisms existing in FYM accelerated the ureaform breaking down process and subsequently, fast release of its nitrogen must be done, particularly, the N-rate of UF4 has been very high. On the other hand, the grape is very sensitive to high nitrogen level and that is why the yield has been injured. This effect was in agreement with the findings of Abbady *et al.* (2006). An opposite direction has been observed in results of UF2, since it has offered maximum yield in case of presence FYM and vice versa. This impact confirmed the previous mentioned fact. Taking the yield of AN treatments as a standard level the relative change could be calculated for the other treatments in percentage value. They have ranged from -23.91 to 49.31 in case of no adding FYM and from -44.42 to 57.3 in case of adding it. In final statement, the optimum rate in case of no adding FYM giving maximum yield has been UF4. The optimum rate in case of presence of FYM has been UF2 since it has attained the highest yield in its.

In year 2006, it must be firstly mentioned that each treatment has been split into two treatments, one of them has again taken the same rate of nitrogen fertilizer tagged by (+) and the other has not tagged by (*) and left to answer the question of: will the residual nitrogen from UF fertilizer give yield as much as that which fertilized again?.

Table (4). Effect of FYM application, slow and fast release nitrogen fertilizers on the yield of Thompson seedless grapevine through two succssive years.

| | Year 2005 | | | | | | | | Year 2006 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Treat. (B) | Pruning weight (kg)/ vine | Cluster weight (kg)/ vine | Cluster No./ vine | Yield (kg)/ vine | Yield (ton/ fed) | Yield relative change to AN value | Yield relative change to AN % | Treat. (C ) | Pruning weight (kg)/ vine | Cluster weight (kg)/ vine | Cluster No./ vine | Yield (kg)/ vine | Yield (ton/ fed) | Yield relative change to AN value | Yield relative change to AN % |
| Without farmyard manure (A) | Control | 2.10 | 0.39 | 20.40 | 7.95 | 7.16 | -2.40 | -24.97 | Cont. | 1.98 | 0.61 | 10.34 | 6.32 | 5.47 | -5.76 | -43.64 |
| | | | | | | | | | Cont. | 1.95 | 0.61 | 10.20 | 6.20 | 5.58 | -7.62 | -67.85 |
| | AN, 80 | 2.22 | 0.45 | 23.70 | 10.68 | 9.61 | 0.00 | 0.00 | AN+ | 2.40 | 0.61 | 24.80 | 14.67 | 13.20 | 0.00 | 0.00 |
| | | | | | | | | | AN* | 2.60 | 0.50 | 24.00 | 12.48 | 11.23 | 0.00 | 0.00 |
| | UF1, 48 | 2.46 | 0.42 | 25.20 | 10.49 | 9.44 | -0.17 | -1.77 | UF1+ | 2.14 | 0.58 | 23.00 | 13.41 | 12.07 | -1.13 | -8.56 |
| | | | | | | | | | UF1* | 2.15 | 0.50 | 23.20 | 11.55 | 10.40 | -0.84 | -7.48 |
| | UF2, 64 | 2.00 | 0.51 | 22.70 | 11.47 | 10.32 | 0.71 | 7.39 | UF2+ | 2.72 | 0.61 | 26.00 | 16.70 | 15.03 | 3.80 | 28.79 |
| | | | | | | | | | UF2* | 2.55 | 0.60 | 27.40 | 15.50 | 13.95 | 0.75 | 6.68 |
| | UF3, 80 | 2.60 | 0.46 | 24.20 | 11.21 | 10.09 | 0.48 | 4.99 | UF3+ | 2.75 | 0.61 | 26.00 | 15.96 | 14.36 | 3.13 | 23.71 |
| | | | | | | | | | UF3* | 2.42 | 0.48 | 26.00 | 12.52 | 11.27 | -1.94 | -17.28 |
| | UF4,96 | 2.40 | 0.67 | 23.40 | 15.61 | 14.05 | 4.44 | 46.20 | UF4+ | 2.60 | 0.55 | 25.20 | 13.92 | 12.53 | 1.30 | 11.58 |
| | | | | | | | | | UF4* | 2.15 | 0.55 | 25.40 | 13.94 | 12.55 | -0.66 | -5.88 |
| | mean | 2.30 | 0.48 | 23.27 | 11.24 | 10.11 | 0.51 | 5.31 | mean+ | 2.43 | 0.59 | 22.56 | 13.50 | 12.11 | 0.22 | 1.98 |
| | | | | | | | | | mean* | 2.30 | 0.54 | 22.70 | 12.03 | 10.83 | -1.72 | -15.30 |
| With farmyard manure | Control | 2.20 | 0.40 | 22.20 | 8.79 | 7.91 | -6.33 | -44.45 | Cont. | 2.00 | 0.63 | 10.80 | 6.84 | 6.16 | -2.17 | -15.58 |
| | | | | | | | | | Cont. | 2.05 | 0.63 | 10.65 | 6.72 | 6.05 | -7.88 | -26.08 |
| | AN, 80 | 2.55 | 0.67 | 23.70 | 15.82 | 14.24 | 0.00 | 0.00 | AN+ | 2.20 | 0.73 | 21.20 | 15.48 | 13.93 | 0.00 | 0.00 |
| | | | | | | | | | AN* | 2.35 | 0.46 | 20.00 | 9.25 | 8.32 | 0.00 | 0.00 |
| | UF1, 48 | 2.11 | 0.57 | 25.60 | 14.57 | 13.11 | -1.13 | -7.94 | UF1+ | 2.50 | 0.52 | 20.80 | 10.91 | 9.82 | 1.50 | 10.77 |
| | | | | | | | | | UF1* | 2.40 | 0.53 | 20.00 | 10.64 | 9.57 | -4.36 | -52.40 |
| | UF2, 64 | 2.62 | 1.01 | 24.70 | 24.89 | 22.40 | 8.16 | 57.30 | UF2+ | 1.98 | 0.47 | 23.00 | 10.85 | 9.76 | -4.17 | -29.94 |
| | | | | | | | | | UF2* | 2.10 | 0.38 | 23.80 | 9.08 | 8.17 | -0.15 | -1.80 |
| | UF3, 80 | 2.65 | 0.57 | 22.60 | 12.79 | 11.51 | -2.73 | -19.17 | UF3+ | 2.65 | 0.75 | 22.20 | 16.65 | 14.98 | 6.66 | 47.81 |
| | | | | | | | | | UF3* | 2.40 | 0.46 | 21.80 | 10.01 | 9.01 | -4.92 | -59.13 |
| | UF4,96 | 2.50 | 0.37 | 23.70 | 8.80 | 7.92 | -6.32 | -44.38 | UF4+ | 2.45 | 0.66 | 22.00 | 14.44 | 12.99 | 4.67 | 33.52 |
| | | | | | | | | | UF4* | 2.30 | 0.38 | 22.20 | 8.36 | 7.52 | -6.41 | -77.04 |
| | mean | 2.44 | 0.60 | 23.75 | 14.28 | 12.85 | -1.39 | -9.77 | mean+ | 2.30 | 0.63 | 20.00 | 12.53 | 11.27 | 1.08 | 7.76 |
| | | | | | | | | | mean* | 2.27 | 0.47 | 19.74 | 9.01 | 8.11 | -3.95 | -36.08 |
| LSD 5% | A | 0.00 | 0.06 | 0.02 | 0.16 | 0.14 | | | LSD A | 0.00 | 0.08 | 0.14 | 0.10 | 0.09 | | |
| | B | 0.01 | 0.04 | 0.03 | 0.11 | 0.10 | | | B | 0.01 | 0.01 | 0.13 | 0.07 | 0.06 | | |
| | A*B | 0.01 | 0.06 | 0.05 | 0.15 | 0.14 | | | C | 0.00 | 0.01 | 0.01 | 0.02 | 0.02 | | |
| | | | | | | | | | A*B | 0.01 | 0.02 | 0.19 | 0.10 | 0.09 | | |
| | | | | | | | | | A*C | 0.00 | 0.01 | 0.01 | 0.03 | 0.03 | | |
| | | | | | | | | | B*C | 0.00 | 0.03 | 0.01 | 0.06 | 0.05 | | |
| | | | | | | | | | A*B*C | 0.01 | 0.04 | 0.02 | 0.08 | 0.07 | | |

AN= ammonium nitrate UF= ureaformaldhid + the experimental unit received N fertilizer in second year

* the experimental unit received N fertilizer in first year only

Examination of data given in Table (4), shows that no significant difference has been noticed between the different treatments either in presence of FYM or not, as regarding to pruning or cluster weight; but there have been significant differences for cluster No./ vine, yield/ vine and yield/ fed. in favor of no presence of FYM. This effect may be explained on the basis of the intensive decomposition of UF caused by bio-constituents of FYM which may lead to liberate some more of its nitrogen and then lose it as affected by soil properties (high pH) or that the yield has been injured by much liberated nitrogen. In this respect, Allice Wise (2002) in its report about grape vine fertilization advised if compost or any other organic matter was in use, nitrogen rates should be reduced.

As for the effect of different treatments on yield and yield components in case of no adding FYM, it is observed that no significant effect for all treatments on each of pruning or cluster weight has been mostly occurred. However, the treatments $NA^+$, $NA^*$, $UF_2^+$, $UF_2^*$, $UF_3^+$ and $UF_3^*$ have given some increasing in cluster No./ vine while UF2*, UF2+ and UF3+ treatments have given higher yield/ vine as well as yield/ fed. than others. While in case of adding FYM, still no significant effect for all treatments has been shown on each of pruning or cluster weight values. Yield/ vine and yield/ fed. values have got approximately decreasing for NA*, UF1*, UF2*, UF3* and UF4* (residual nitrogen treatments) whereas AN+, UF3+ and UF4+ (residual nitrogen + again N added treatments) have given rational values for each yield/ vine and yield/ fed.

As for the final split treatments tagged with + or *, it is observed that no significant difference between pruning or cluster weight and cluster No./ vine has been occurred whether in presence of FYM or not. As regard the yield/ vine and yield/ fed., no certain direction has been noticed, they have been sometimes the same and other times they have been more or less. This may be due to the adaptation supposed to be between the soil medium and UF fertilizer has not yet accomplished. It is however, observed that yield/ vine and yield/ fed. Values, on average, of both residual and residual+ adding ureaform treatments have been approximated to those of AN treatment currently fertilized. It seems that the residual ureaform nitrogen has been acted as posts harvesting fertilization and bulbs has been got as stores to nitrogen element and have not needed supplemental nourishment to help plant give a good yield. Also in this respect, Golugnati *et al.* (1997) stated that the slow release fertilizers application achieved more balanced plants. The relative change in the year 2006 has ranged between -17.28 to 28.71 for treatments without FYM application, and from -77.04 to 47.81 with FYM application.

**3- Economic evaluation**

The major disadvantage of slow release nitrogen fertilizer, in general, is their high cost as compared to conventional readily soluble nitrogen fertilizers. However, if it is taken into consideration the magnitude of their efficiency (80-90%, Abbady *et al.*, 2003) the situation may be positively changed. Here, Table (5) show calculation of costs, gross return, net return and investment factor (IF) for grape yield at both years as well as the final calculation throughout the experiment.

The expenditure involved in the purchase and application of fast or slow release fertilizer as inputs can be totalized in:

Ammonium nitrate (33.5% N) 800 L.E. for one ton.

Ureaform (40% N) 1900 L.E. for one ton, representing urea price for 1 ton+ price of some other chemicals which are necessity to manufacture 1 ton of it.

Labour of adding fertilizer 15 L.E. for fed./ time, labour of adding FYM 35 L.E. for 10 $m^3$.

The output representing in sold price of grape yield has taken 1500 L.E. for 1 ton

T5

It must be mentioned that the cost of known other agriculture processes (pesticides, fuel, repairing, …. etc) have not been included and also the yield increase has been only referred to the effect of the studied different treatments.

Obviously, at year 2005 and regardless of different treatments, the presence of FYM has positively affected net return and investment factor (Table 5). Net return and IF values of UF treatments (on average) has been superior to those of AN treatment in case of no adding FYM and opposite direction has been appeared in case of presence of FYM.

The results has suggested the UF4 rate (96 kg N/fed) without FYM and UF2 rate (64 kg N/ fed) with FYM to be the optimum rate from ureaform to attain maximum profitability. The result of year 2006 is the most important limiting factor to determine the profitability quantity because of being dealt with the lasting nitrogen portion after the previous nitrogenous depletion at year 2005.

As for net return, it is astonished that the yield increase of treatments tagged (*) referring to the effect of lasting portion of UF-nitrogen at year 2006 has been greater than those of 2005 in case of no adding FYM and less in case of adding it. Regardless of different treatments, the presence of FYM has negatively affected net return values.

As for the effect of different treatments on net return, it has found that in case of no adding FYM, the net return of UF treatments (on average) has been superior to that of AN treatment. The contrary trend has been true in case of adding it. The final observations, the treatments have received new addition of nitrogen fertilizers either fast or slow release which tagged (+) have given net return greater than those which have not (*) either in presence of FYM or not.

To decide the extent of the importance of this study, final calculation of inputs and outputs (Table 5) must be well discussed. In general, the data indicate that the application of both fast and slow release forms of nitrogen fertilizers have been profitable since their IF values have frequently been more than 3 (FAO, 2000). Net return of UF treatments (on average) has been greater than that of AN treatment in case of no adding FYM and less in case of adding it. The most important result is although the net return of treatments tagged (+), on average, has been more than those of tagged (*) either in adding FYM or not, their IF (on average) has always been less. This means that the highest yield/ fed does not necessarily mean the highest return.

Fig (1) illustrate the relation between the impact of different UF-rates and each of total yield increase, net return of 2$^{nd}$ and 3$^{rd}$ year with or without FYM application. on the basis of IF, it could be selected the rates of UF2 and UF4 in case of absent FYM, UF2 in case of presence it, to be the optimum rates from economical point of view.

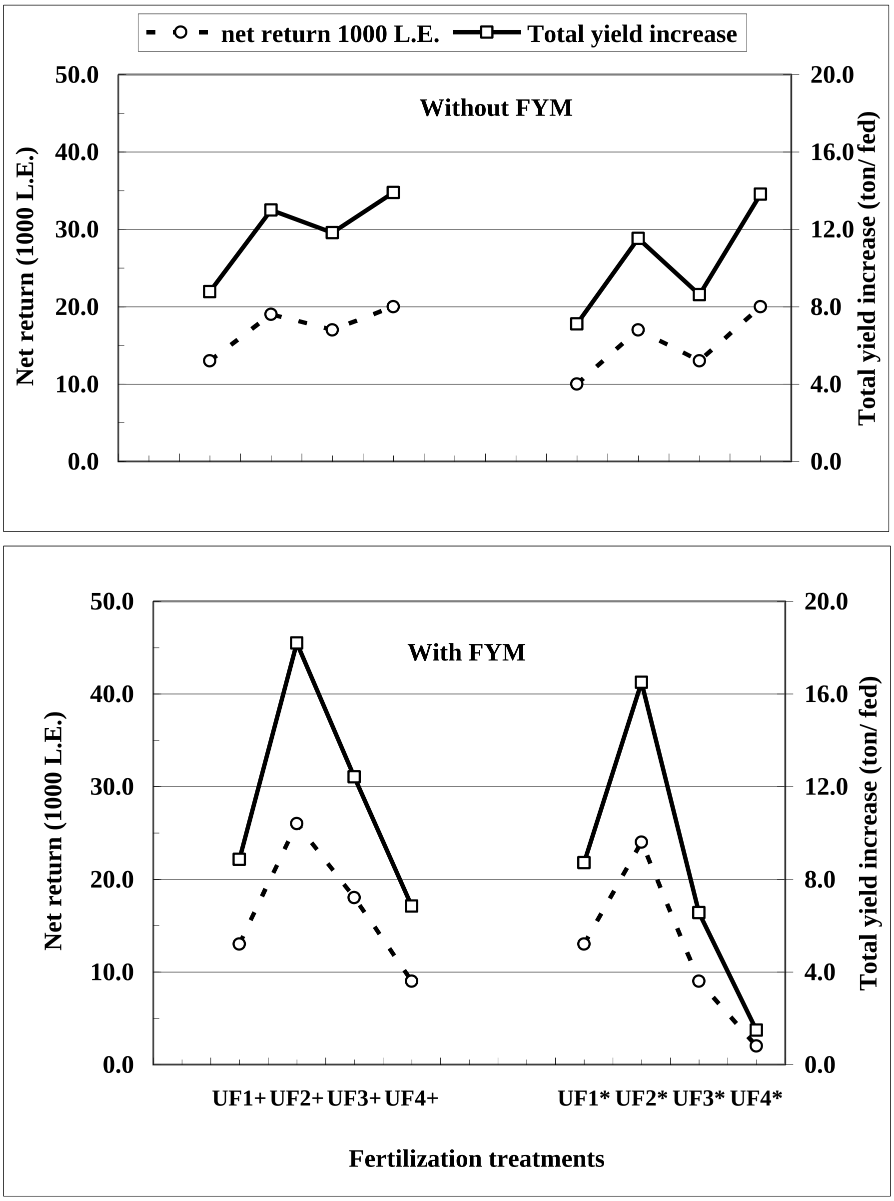


**Fig. (1). Ureaform treatments in relation to total yield increase and net return.**

In conclusion, the positive perspective of this study has emphasized on the importance of slow release nitrogen fertilizers application; the results have shown the continuation of UF-nitrogen release till the year 2006 in sufficient quantity to meet the nutritive grapes requirements, so that the productivity in the year 2006 has been greater than that of 2005. The rate of 96 kg N/ fed has been efficient to fertilize the grapevine and if FYM has been in use, it should be reduced to the half (48 kg N/ fed). This practice guarantees production of good yield (quality and quantity) and also high profitability comparing to the ordinary N-fertilization. Finally, the inestimable environmental return must be taken into consideration.

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## منهج مستحدث لتسميد كروم العنب

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يعتبر تسميد كروم العنب أحد العمليات الزراعية الحساسة، خاصة الاهتمام بحزمة من الإدارة المزرعية. وقد أقيمت هذه التجربة لمدة ثلاث سنوات متوالية (2004، 2005، 2006) فى مزرعة خاصة فى منطقة الخطاطبة بمحافظة المنوفية، وذلك لدراسة تأثير استخدام اليوريافورم كسماد بطئ الذوبان مقارنة بالأمونيوم نيترات كسماد سريع الذوبان فى وجود أو عدم وجود السماد البلدى على الصفات المورفولوجية والصفات الكيميائية والمحصول ومكوناته المتعلقة بكرمات العنب طومسون عديم البذور. وتم تقدير العائد الاقتصادى. وكانت المعاملات كالاتى : سماد بلدى (صفر، 30م3 فدان) كمعاملة رئيسية والمعاملات الشقية هى نترات الامونيوم بمعدل 80 كجم نيتروجين/ فدان ( المعدل الموصى به ) و4 معدلات من اليوريافورم 48, 64 , 80 , 96 كجم نيتروجين / فدان بالاضافة لمعاملة الكنترول . وعند بداية العام الثالث شقت المعاملات مرة اخرى الى معاملتين حيث سمدت احداهما بنفس نوع ومعدل السماد المستخدم فى الموسم الثانى وتركت الاخرى دون تسميد لاختبار تأثير النتروجين المتبقى.

**وجاءت النتائج كالاتى:**

- لا يوجد فروق معنوية بين المعاملات فى التأثير على الخواص المورفولوجية فيما عدا مساحة الورقة التى استجابت بطريقة واضحة لكل من معاملات اليوريافورم والسماد البلدى . ولوحظ ارتفاع قيم هذة الخواص فى السنة الثالثة اذا ما قورنت بالسنة الثانية.
- فيما يخص الخواص والمكونات الكيميائية , اعطت كل المعاملات محصول ذو نوعية جيدة وكان التفاوت غير ملحوظ . الا انه لوحظ تدنى قيم السكريات الكلية والمواد الصلبة وزيادة الحموضة فى الظروف التى يتوقع فيها تواجد وفرة من النتروجين الميسر ( المعدلات العالية + FYM ).
- بالنسبة للمحصول ومكوناته : لوحظ تأثير ايجابى لكل من معاملات اليوريافورم والسماد البلدى على محصول العنب/ كرمة , وزن العنقود , المحصول عنب / فدان . وكان المعدل 96 كجم نتروجين / فدان فى حالة عدم وجود السماد البلدى. والمعدل 48 كجم نتروجين/ فدان فى حالة اضافة السماد البلدى هما الأكثر تفوقاً فى العام الثانى. بينما فى العام الثالث لم يكن للسماد البلدى تأثير على المحصول ومكوناته بل على العكس المعاملات النتروجينية بدون اضافة السماد البلدى اعطت المحصول الاكبر. لوحظ ايضا ان محصول معاملات اليوريافورم ( الجزء المتبقى ) اكبر من محصول السنة الثانية. كما اعطت المعاملات الشقية المؤشرة (+) محصول اكبرمن قرينتها التى لم تتلقى اى تسميد بصرف النظر عن المعدل والنوع.
- فيما يخص التقييم الاقتصادى : تفوقت معاملات اليوريافورم (حسب المتوسط ) على معاملة الامونيوم نيترات فى قيمة صافى العائد ومعامل الاستثمار فى عدم وجود السماد البلدى . والعكس كان صحيحا فى حالة وجود السماد البلدى. واتضح ان امثل المعدلات لتحقيق اقصى اربحية من اليوريافورم هما 96 كجم نتروجين / فدان بدون اضافة سماد بلدى أو 48 كجم نتروجين / فدان مع اضافة السماد البلدى هذا فى السنة الثانية. بينما فى السنة الثالثة ولان محصول معاملات اليوريافورم فى هذه السنة كان اعلى من السنة الثانية فى كلا النوعين من المعاملات الشقية الاخيرة (+ ،*) فقد كان صافى العائد لهما كبيرا مقارنة بالسنة الثانية.
- ولأن الربحية تتحدد بمعامل الاستثمار , فقد اتضح ان المعاملات التى لم تتلقى اسمدة فى السنة الثالثة هى الاكثر أربحية رغم ان عائدها الصافى اقل من تلك التى سمدت مرة ثانية . وهذا يعنى ان اعلى محصول لا يعنى بالضرورة اعلى اربحية. ومازال المعدل 96 كجم نتروجين / فدان من اليوريافورم بدون سماد بلدى والمعدل 48 كجم نتروجين / فدان من اليوريافورم والسماد البلدى هما الاكثر اربحية.

Table ( 5 ). Yield increase, gross return, net return and investment factor (IF) produced from application of different treatments on Thompson seedless grapevines in two years.

| Treatment | | Year 2005 | | | | | | | | | | Year 2006 | | | | | | | | | | Final position for return / fed | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Treat. (B) | Applied fertilizer kg/fed | Fertilizer cost | labour/ fed for fertilization | applied FYM m3/fed | cost of adding FYM / fed | total cost / fed | yield increase ton/ fed | gross return at market rate L.E. | net retrun L.E. | Investment factor | Treat. (C ) | Applied fertilizer kg/fed | Fertilizer cost | labour/ fed for fertilization | applied FYM m3/fed | cost of adding FYM / fed | total cost / fed | yield increase ton/ fed | gross return at market rate L.E. | net retrun L.E. | total yield increase / fed | total cost L.E. | gross return at market rate L.E. | net retrun L.E. | Investment factor |
| Without organic manure (A) | AN | 250 | 200 | 135 | 0.00 | 0.00 | 335 | 2.25 | 3375 | 3040 | 10.00 | AN+ | 250 | 200 | 135 | 0.00 | 0.00 | 335 | 7.62 | 11430 | 11075 | 9.87 | 670 | 14805 | 14135 | 22.09 |
| | | | | | | | | | | | | AN* | 0 | 0 | 0 | 0.00 | 0.00 | 0 | 5.67 | 8505 | 8505 | 7.92 | 335 | 11880 | 11465 | 35.46 |
| | UF1 | 120 | 228 | 45 | 0.00 | 0.00 | 273 | 2.28 | 3420 | 3147 | 11.53 | UF1+ | 120 | 228 | 45 | 0.00 | 0.00 | 273 | 6.49 | 9735 | 9462 | 8.77 | 546 | 13155 | 12609 | 24.09 |
| | | | | | | | | | | | | UF1* | 0 | 0 | 0 | 0.00 | 0.00 | 0 | 4.82 | 6480 | 6480 | 7.10 | 273 | 9900 | 9627 | 36.26 |
| | UF2 | 160 | 304 | 45 | 0.00 | 0.00 | 349 | 3.16 | 4740 | 4391 | 12.58 | UF2+ | 160 | 304 | 45 | 0.00 | 0.00 | 349 | 9.83 | 14745 | 14396 | 12.99 | 690 | 19485 | 18795 | 28.24 |
| | | | | | | | | | | | | UF2* | 0 | 0 | 0 | 0.00 | 0.00 | 0 | 8.37 | 12555 | 12555 | 11.53 | 349 | 17295 | 16946 | 49.56 |
| | UF3 | 200 | 380 | 45 | 0.00 | 0.00 | 425 | 2.93 | 4395 | 3970 | 10.34 | UF3+ | 200 | 380 | 45 | 0.00 | 0.00 | 425 | 8.89 | 13335 | 12878 | 11.82 | 850 | 17730 | 16880 | 20.86 |
| | | | | | | | | | | | | UF3* | 0 | 0 | 0 | 0.00 | 0.00 | 0 | 5.69 | 8535 | 8535 | 8.62 | 425 | 12930 | 12505 | 30.42 |
| | UF4 | 240 | 456 | 45 | 0.00 | 0.00 | 501 | 6.89 | 10335 | 9834 | 20.63 | UF4+ | 240 | 456 | 45 | 0.00 | 0.00 | 501 | 7.06 | 10590 | 10089 | 13.90 | 1002 | 20925 | 19923 | 20.88 |
| | | | | | | | | | | | | UF4* | 0 | 0 | 0 | 0.00 | 0.00 | 0 | 6.97 | 10455 | 10455 | 13.81 | 501 | 20790 | 20289 | 41.50 |
| | mean | 194.00 | 313.60 | 63.00 | 0.00 | 0.00 | 376.60 | 3.50 | 5253.00 | 4876.40 | 13.02 | mean | 194.00 | 313.60 | 63.00 | 0.00 | 0.00 | 376.60 | 7.14 | 10636.50 | 10443.00 | 10.63 | 564.10 | 15889.50 | 15317.40 | 30.94 |
| With organic manure (A) | AN | 250 | 200 | 135 | 30 | 105 | 440 | 6.33 | 9495 | 9055 | 21.58 | AN+ | 250 | 200 | 135 | 0.00 | 0.00 | 335 | 7.27 | 10905 | 10570 | 13.60 | 775 | 20400 | 19625 | 26.32 |
| | | | | | | | | | | | | AN* | 0 | 0 | 0 | 0.00 | 0.00 | 0 | 2.27 | 3405 | 3405 | 8.60 | 440 | 12900 | 12460 | 29.32 |
| | UF1 | 120 | 228 | 45 | 30 | 105 | 378 | 5.20 | 7800 | 7422 | 20.64 | UF1+ | 120 | 228 | 45 | 0.00 | 0.00 | 273 | 3.66 | 5490 | 5217 | 8.86 | 651 | 13290 | 12639 | 20.42 |
| | | | | | | | | | | | | UF1* | 0 | 0 | 0 | 0.00 | 0.00 | 0 | 3.52 | 5280 | 5280 | 8.72 | 378 | 13080 | 12702 | 34.60 |
| | UF2 | 160 | 304 | 45 | 30 | 105 | 454 | 14.49 | 21735 | 21281 | 47.88 | UF2+ | 160 | 304 | 45 | 0.00 | 0.00 | 349 | 3.71 | 5565 | 5216 | 18.20 | 803 | 27300 | 26497 | 34.00 |
| | | | | | | | | | | | | UF2* | 0 | 0 | 0 | 0.00 | 0.00 | 0 | 2.01 | 3015 | 3015 | 16.50 | 454 | 24750 | 24296 | 54.52 |
| | UF3 | 200 | 380 | 45 | 30 | 105 | 530 | 3.60 | 5400 | 4870 | 10.19 | UF3+ | 200 | 380 | 45 | 0.00 | 0.00 | 425 | 8.82 | 13230 | 12805 | 12.42 | 955 | 18630 | 17675 | 19.51 |
| | | | | | | | | | | | | UF3* | 0 | 0 | 0 | 0.00 | 0.00 | 0 | 2.96 | 4440 | 4440 | 6.56 | 530 | 9840 | 9310 | 18.57 |
| | UF4 | 240 | 456 | 45 | 30 | 105 | 606 | 0.01 | 15 | -591 | -0.98 | UF4+ | 240 | 456 | 45 | 0.00 | 0.00 | 501 | 6.83 | 10245 | 9744 | 6.84 | 1107 | 10260 | 9153 | 9.27 |
| | | | | | | | | | | | | UF4* | 0 | 0 | 0 | 0.00 | 0.00 | 0.00 | 1.47 | 2205 | 2205 | 1.48 | 606 | 2220 | 1614 | 3.66 |
| | mean | 194.00 | 313.60 | 63.00 | 30.00 | 105.00 | 481.60 | 5.93 | 8889.00 | 8407.40 | 19.86 | mean | 194.00 | 313.60 | 63.00 | 0.00 | 0.00 | 376.60 | 4.25 | 6378.00 | 6189.70 | 10.18 | 669.90 | 15267.00 | 14597.10 | 25.02 |

Yield increase= the difference between yield of the treatment and the yield of control

Gross retun= value of yield increase (in terms of money)

Net return= gross return - total cost

Investment factor= gross return (L.E.)/ total cost (L.E.)