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IMPROVED METHOD OF NITROGEN APPLICATION IN THE VINEYARDS

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Abstract: S-au studiat deşeurile minerale solide compostate (C) în calitate de sursă ecologică de acid humic (HA) cu şi fără pulverizare cu extract de drojdie (Y) în calitate de bioîngrăşământ cu scopul înlocuirii parţiale a aplicării îngrăşămintelor minerale de azot asupra viţei de vie din soiul Thomson.

S-a stabilit că aplicarea a 50% N + 50% C + 1% HA a sporit conţinutul de NPK în frunze şi calitatea producţiei. Ultima a fost mai pronunţată în combinaţie cu pulverizarea cu extract de drojdie. Toate tratamentele au redus conţinutul de azot din suc.

Key words: Bio-fertilizer, Grapevine, Fertilization, Humic acid, Nitrogen, Nitrate, Nitrite, Organic.

INTRODUCTION

Nitrogen plays a key role in enhancing the growth, nutritional status, improving yield and fruit quality in different grapevine varieties (A.A. Gobara *et al*., 1998; A. Ali-Mervet, 2000). Mineral nitrogen fertilization causes harmful residues of nitrate and nitrite (NO^{-3} and NO^{-2}) in grapefruits (A.S. Montasser

et al., 2003; S.G. Farag, 2006). Nowadays, it is doubtless that new fertilization techniques have been developed in different vineyards located in newly reclaimed areas, where, organic fertilization (in composting phase) of various grapevines has called the attention of researchers as a positive alternative to minimize the intensive amounts of mineral N (H.A. Kassem, H.A.Marzouk, 2002). Moreover, the necessity to use humic acid together with organic fertilizer for improving vine growth, nutritional status and berry quality, was supported by many experimental results (R.F. Zhu, R.F. Zhu, 2000; B.J. Guo *et a*l, 2000; M. Ali *et al*., 2006; A.A. Eman *et al*, 2008). Organic and bio-fertilizations are very safe for consumers, due to the fact that their application leads to reduce the accumulation of nitrate and nitrite residues in the edible tissues (A.S. Montasser *et al,* 2003; S.G. Farag, 2006). Also, some vine growers call out for using yeast as a natural bio-stimulator for improving the growth and productivity of grapevines, since, it has three basic functions, i.e. CO_2 production, formation of the natural hormone Cytokines and after the decomposition it develops a wide group of amino acids and B vitamins (James Bonner, 1994).

In Egypt, the possibility of using bio-fertilizers in fruit orchards was mentioned by a number of researches and scientists (F.F. Ahmed *et al*.,1997; A.E.M. Mansour, 1998; S.A. Abou Taleb *et al*., 1999; El-Shammaa, Abd-hady,2000; M.M.M. Abd El-Migeed *et al*. 2006).

Therefore, the present work was initiated in order to study the possibility of using compost (as organic fertilizer), humic acid and partially active dry yeast in Thomson seedless grapevines, as safe fertilizers instead of mineral nitrogen.

MATERIAL AND METHODS

This study was conducted during two successive seasons 2010 and 2011 on 10 years old, head trained Thomson seedless grapevine. Vines were pruned leaving 10 fruiting spurs x 7 buds plus 6 replacements spurs x 2 buds with a total vine load of 82 buds. The tested vines were chosen to be as uniform as possible in vigor and grown in a private vineyard located in Cairo/Alexandria desert road. Vines were planted in sandy soil (Table 1), spaced at 2x2 meters apart under drip irrigation system. A complete randomized block design was arranged and every treatment was replicated 3 times, one vine per each.

Table 1

Analysis of the tested soil

Texture	Chemical analysis						
	N%	P%	K%	Ca co3%	E c mmhos/1 cm	O. M %	Ph 1: 2.5
Sand 62.5 %	2.18	1.14	0.58	4.33	0.96	2.18	8.1

Treatments were applied as follows:

1- 100% mineral. 100g N / vine (control).
2- 100 % compost. (12 Kg equal to N value in control)
3- 50% mineral N + 50% compost.
4- 50% mineral N + 1% HA. (Humix12% humic acid)
5- 50% mineral N + (2 gm. / L) yeast extract.
6- 50% mineral N + 50% compost + 1% HA.
7- 50% mineral N + 50% compost + yeast extract.
8- 50% mineral N + 50% compost + 1% HA + yeast extract.

All the regular horticultural practices have been done as usual except those with compost and humic acid which were applied during January. Mineral nitrogen was applied in the form of ammonium sulphate (20.5 % N) in four equal doses (i.e. bud burst, after berry set, 30 and 60 days later). Dry yeast (*Saccharomyces cerevisae*) was activated by dissolving a definite amount (2 g/L) in warm water (38^{o}C) adding sugar at the same rate, and keeping it over night in a warm place for nearly 12 hours before filtering and spraying it (L/vine). Yeast extract was sprayed twice a year: in the first week of May and 30 days later. Physical and chemical analysis of the used compost is shown in Table 2.

Percentages of N, P and K contents were determined in the petioles of twenty leaves/ vine, where N was determined as *ppm* in mature berry juice according to S.A. Wild et al., (1985). At harvesting date, the number and weight of clusters/vine were recorded, and the yield / vine (Kg.) was calculated.

Table 2

Analysis of the used compost

Moisture content (%)	18. 40	Total nitrogen (%)	2. 77
pH value (1: 10)	8. 36	Soluble ammonium (%)	0. 26
EC value (1: 10) mmhos / cm	8. 42	Soluble nitrate (%)	0. 06
Organic carbon (%)	37. 50	C / N ratio	21. 4
	20. 35	Phosphorus (%)	1. 65
Organic matter (%)	69. 80	Potassium (%)	1. 59

Five clusters / treatment were taken at random in order to determine the weight of 100 berries, total soluble solids % and total acidity (*gm*.tartaric acid/100 *ml*. juice) according to A.O.A.C (1985). Nitrate and nitrite content was determined in the berry extract according to N.P. Sen, B.D. Donaldson (1978). The obtained data have been statistically analyzed using D.B. Duncan's multiple range tests (1955).

RESULTS AND DISCUSSIONS

Effect on leaf N, P and K contents

Table 3. clearly shows that leaf nitrogen percentage was significantly higher in vines treated with100% mineral nitrogen (control), during both seasons. During the first season, the decrease in N rate to 50% with either fertilizer combinations (*i.e* compost(C), H.A, yeast (Y)) was followed by a significant reduction of leaf N content than in the control variant. While in the second season, vines treated with N at 50% dominated, being combined with either T6 (C + H.A) or T8 (C+H.A+Y). As regarding Potassium content, the data showed that leaf K content was highly affected by either T4 (N+H.A) or T5 (N+Y) treatments, during the first season. This effect was more pronounced and significant for T6 & T8 during the second season. As for leaf phosphorus content, no significant

Table 3

L*eaf mineral content, numbers & weight of clusters and yield of Thompson seedless grape variety as affected by Mineral, Organic and Bio-fertilizers.*

Treatments	N%	P %	K %	no. of clusters/vine	cluster Wt.g	Yield (Kg)/vine
Season 2010						
T1 100 % mineral *N*	1. 94 a	0.138	1.42 ab	23.1	511 a	11.80 a
T2 100 % compost (C)	1. 38 c	0.119	1.24 c	21.7	407 c	8.43 c
T3 50%mineral *N*+50% C	1. 29 c	0.127	1.35 bc	21.2	386 cd	8.18 c
T4 50% mineral *N* + 1% HA	1. 51 bc	0.135	1.51 a	21.9	425 bc	9.31 b
T5 50% mineral *N* +yeast(Y)	1. 61 b	0.121	1.48 a	22.1	443 b	9.79 b
T6 50%N+50% C+1% HA	1. 80 a	0.127	1.41 b	22.7	481 ab	10.92 a
T7 50% *N*+50% C+ yeast	1. 68 b	0.125	1.40 b	22.4	462 b	10.35 ab
T8 50%*N*+50% C+1% HA +Y	1. 85 a	0.132	1.45 ab	22.9	502 a	11.50 a
Significance at 5% level	S	NS	S	NS	S	S
Season 2011						
T1 100 % mineral *N*	2. 40 a	0.132	1.40 c	24.2	544 a	13.17 a
T2 100 % compost (C)	1. 86 b	0.119	1.44 c	22.9	456 bc	10.44 bc
T3 50%mineral *N*+50% C	1. 62 bc	0.117	1.50 b	22.5	442 c	9.95 c
T4 50% mineral *N* + 1% HA	1. 55 c	0.126	1.58 ab	22.3	414 cd	9.23 cd
T5 50% mineral *N* +yeast(Y)	1. 98 b	0.122	1.37 cd	23.2	471 b	10.93 bc
T6 50%N+50% C +1% HA	2.23 ab	0.130	1.62 a	23.8	508 ab	12.09 ab
T7 50% *N*+50% C + yeast	2. 08 b	0.128	1.59 ab	23.6	490 b	11.56 b
T8 50%*N*+50% C +1% HA+Y	2. 29 a	0.129	1.66 a	24.0	526 a	12.62 a
Significance at 5% level	S	NS	S	NS	S	S

The methods having the same letter (s) within a column are not significantly different at 5% level.
(C) = Compost
(Y)=Yeast
* Total acid as tartaric acid/ 100ml juice

difference was noticed between different fertilizer treatments for both seasons. The improving effect of N and organic fertilizers was supported by such researchers as Gobara et al.,1998 and Ali – Mervet, 2000 who worked on nitrogen levels; F.F. Ahmed et al (1997); A.E.M. Mansour (1998) who worked on bio-fertilizers and A.A. Eman et al. (2008) who worked on organic and mineral fertilization.

Effect on the number and weight of clusters and yield of vines

In respect of the number of clusters/vine, the data in Table 3 did not reflect any significant differences between the eight fertilizer treatments. Contrarily, the cluster weight as well as total yield/vine were significantly affected in both studied seasons, where the control variant (100% N) as well as T8 (N+C+H.A+Y) followed by T6 (N+C+H.A) were the most effective, producing the highest weight of clusters and yield values. The least significant values were obtained for vines fertilized with either T3 (50%N+C), during the first season or T4 (N+H.A), during the second one. The beneficial effects of organic and bio-fertilization treatments on the total yield were in harmony with those obtained by H.A. Kassem; H.A. Marzouk, 2002; A.H. Omar 2005 and S.G. Farag, 2006.

Effect on fruit quality

The results presented in Table 4. show the effect of different treatments on total nitrogen, nitrate, nitrite, TSS% and acidity in berry juice. During both seasons, the collected data indicated that vines fertilization with 100% mineral N reveals the highest values of total nitrogen, nitrate and nitrite content in berry juice followed in a descending order by T5 (50%N+Y). Contrarily, the berry juice with less N, NO^{-3} and NO^{-2} values was significantly obtained from vines treated either with compost alone or as combined with T8 (50%N+H.A+Y). Regarding total soluble solids, data clearly show that either T4 (N+H.A) or T5 (N+Y) followed in a descending order by T8 (N+C+H.A+Y) were preferable in improving juice TSS% than the control variant in the first season. But during the second season, there was noticed a different trend, where T8 (N+C+H.A+Y), T6 (N+C+H.A) and T7 (N+C+Y) significantly dominated the control and T5 (N+Y) which recorded the least TSS percentage values. As for acidity,

Table 4

Total nitrogen, nitrate, nitrite, TSS% and acidity in the berry juice of Thompson seedless grape variety as affected by mineral, compost, HA and Bio-fertilizers.

Treatments	Total N (*ppm*)	NO^{-3} (*ppm*)	NO^{-2} (*ppm*)	TSS%	* Acidity
Season 2010					
T1 100 % mineral *N*	786 a	19.3 a	0.30 a	17.3 b	0.51
T2 100 % compost (C)	432 cd	11.9 c	0.18 bc	15.7 cd	0.49
T3 50%mineral *N* + 50% C	705 ab	17.2 b	0.26 ab	16.1 c	0.49
T4 50% mineral *N* + 1% HA	649 b	16.1 b	.024 ab	18.3 a	0.52
T5 50% mineral *N*+yeast(Y)	751 ab	18.1 ab	0.28 a	18.2 a	0.51
T6 50%N+50% C+1%HA	536 c	14.3 bc	0.20 b	16.9 b	0.50
T7 50% *N*+50% C+ yeast	601 b	15.2 bc	0.22 b	16.5 bc	0.52
T8 50%*N*+50% C+1% HA+Y	470 cd	13.1 c	0.19 bc	17.9 ab	0.51
Significance at 5% level	S	S	S	S	NS
Season 2011					
T1 100 % mineral *N*	874 a	21.1 a	0.33 a	16.9 c	0.56
T2 100 % compost (C)	568 c	12.6 cd	0.19 cd	17.5 bc	0.58
T3 50 %mineral *N* + 50% C	776 ab	19.2 ab	0.31 a	17.8 b	0.57
T4 50 % mineral *N* + 1% HA	729 b	17.7 b	0.28 ab	18.3 ab	0.58
T5 50% mineral *N*+yeast(Y)	823 a	20.3 a	0.32 a	16.4 c	0.57
T6 50 % N+50% C + 1% HA	635 bc	14.7 bc	0.23 c	19.0 a	0.59
T7 50% *N* + 50% C+ yeast	684 b	16.0 b	0.26 b	18.7 a	0.57
T8 50%*N* +50% C+1% HA+Y	597 c	13.1 c	0.21 cd	19.1 a	0.59
Significance at 5% level	S	S	S	S	NS

The methods having the same letter (s) within a column are not significantly different at 5% level.
(C) = Compost (Y) = Yeast
* Total acid as tartaric acid/ 100ml juice.

no significant differences were noticed in juice acidity between different fertilizer treatments in both seasons. The results, obtained by A.S. Montasser *et al,* 2003; F.E. Elshenawy, T.A. Fayed, 2005; S.G. Farag 2006 ; Abd El-Migeed *et a*l, 2006, indicated that the excessive use of nitrogen led to the accumulation of nitrate and nitrite in edible tissues. The positive effect of organic and bio-fertilizers on improving yield and fruit quality, may be attributed to reducing vine requirements of N, enhancing the availability of various nutrients and reducing residues induced by the application of mineral fertilizers (S.M. Shehata *et al* (2001)).

CONCLUSIONS

The best results have been obtained by fertilizing the grapevine with combinations of mineral N at 50g, compost and humic acid with or without spraying yeast extract, in order to achieve an economical yield and obtaining berries characterized by high quality and more safety. This means that the use of organic and bio-fertilizers leads to a reduction of mineral pollution.

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