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EFFECT OF HUMIC ACID, COMPOST AND BIOFERTILIZATION ON FRUITING OF SUPERIOR SEEDLESS GRAPEVINES

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ABSTRACT

Superior grapevines fertilized with compost, biofertilizers namely (Bacillus megatherium, Bacillus curculanse and Azotoacter Chroococcum), humic acid and two slow release fertilizers namely (rock phosphate and feldspar) as a partial replacement of mineral N fertilizers during 2013 and 2014 seasons. Using all substitutes of mineral N fertilizers was favourable than using mineral N alone in enhancing all growth characters, total chlorophylls, nutrients, yield and berries characteristics. Both nitrite and nitrate in the juice were greatly declined in all N management treatments that included the application of all N sources. The best results with regards to yield and berries characteristics of Superior seedless grapevines were recorded on vines that received 60g N, 60g P and 120g K/ vine/ year (mineral sources) plus compost II (40% cattle manure + 60% rice straw) at 16 kg./ vine+ the three biofertilizers namely Bacillus megatheium, Bacillus circulanse and Azotobacter chroococcum + humic acid each at 10ml./ vine/ year

INTRODUCTION

Poor yield of Superior grapevines grown under sandy soil is suggested to be a major problem that face grapvines growers. The main cause of this problem is the excessive used of N especially when applied via isnorganic N source alone (**Weaver, 1976**). This is reflected on producting more shoots at the expense of fruiting. Making a balance between all sources (organic and biofertilization) is necessary for overcoming this problem **(Nijjar, 1985 and Davis and Ghabbour, 1998).** Organic and biofertilization enhances soil fertility, N fixation, microbial activity, hormones, antibiotics secretion and B vitamins (**Kannaiyan, 2002**).

A partial replacement of inorganic N fertilizers by using organic and biofirtilization accompanied with improving yield and fruit characteristics in different grapevine cvs **(Abd El-Hady, 2003; Ahmed et al 2003; Abd El-Hameed et al 2004; El-Khafagy, 2006; Farag, 2006; Saleh et al 2006; Abd El-aal et al 2007; Masoud, 2008; Ahmed and Ibrahiem – Asmaa, 2009; Abada et al 2010 and Abd El-Aziz, 2011. Allam–Aida, (2012); Mekawy, (2012); Shaaban, (2014) and El-Wany, (2015)** suggested that using organic manures enriched with microorganisms as apartial replacement of mineral N was followed by enhancing fruit quality.

The target of this study was examining the effect of using compost, humic acid and biofertilizers as a partial substitute of mineral N fertilizer on fruiting of Superior grapevines.

MATERIALS AND METHODS

This study was carried out during 2013 and 2014 seasons on 48 uniform in vigour 7- years old cane trained Superior seedless grapevines grown in a private vineyard located at El- Bustan, Noubaric district, El- Behaira Governorate. The vineyard soil texture is sandy soil and well drained and with a water table not less than two meters deep **(Table 1)** (**Black et al 1965 and Wilde et al 1985**).

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Table 1. Analysis of the tested soil

Constituent	Values
Particle size distribution	
Sand %	66.0
Silt %	14.0
Clay %	20.0
Extract	Sandy
pH (texture 1: 2.5)	7.8
E.C. (1: 2.5 (mmhos/ 1 cm/ 25^{o}C)	0.74
O.M. %	1.00
Total N %	0.03
Available P (olsen, ppm)	1.2
Available K (ppm ammonium acitate)	41.0

Vine load was adjusted to be 120 vines for all the selected vines in the basis of ten fruiting canes plus ten renewal spurs x two eyes. Winter pruning was done on the first week of Jan. during both seasons. The vines planted at 2.5 x 3.5 m apart. Gable supporting system was followed.

This experiment included sixteen treatments from three factors (A & B & C). The first factor (A) consisted from two types of compost namely a_1) compost I (Herbs and medical plant resides) and a_2) compost II (40% cattle manure + 60% rice straw). The second factor (B) contained the following four levels of compost and the two slow release fertilizers namely rock phosphate and feldspar:-

b_1) Using mineral N, P and K at 60, 60 and 120 g./ vine/ year, respectively without compost and the two slow release fertilizers namely rock phosphate and feldspar.

b_2) Compost at 50 g. N/ vine (14 kg/ vine/ year) + 0.375 kg/ vine/ year rock phosphate + 0.714 kg/ vine/ year feldspar).

b_3) Compost at 60 g. N/ vine (16 kg/ vine/ year) + 0.428 kg/ vine/ year rock phosphate + 0.857 kg. feldspar / vine/ year).

b_4) Compost at 70g. N/ vine (20 kg/ vine/ year) + 0.5 kg/ vine/ year rock phosphate + 1.0 kg/ vine/ year feldspar).

The thirds factor (C) consisted from the following two treatments of mineral N, P and K , biofertilizers and humic acid.

C_1) Using mineral N, P and K at 60,60 and 120g. /vine/ year, respectively alone.

C_2) Vines received N, P, K at 60, 60 and 120 g./ vine + the three strains of biofertilizers namely *Bacillus megatherium, Bacillus circulanse* and *Azotobacter chroococcum* + humic acid each at 10ml./ vine/ year.

Each treatment was replicated three times, one vine per each. Compost was added once at the middle of January. Both humic acid and three biofertilizers each at 10 ml / vine were added once at the first week of February.

Table 2. Analysis of the used compost

Constituents	Compost I	Compost II
Humidity %	29.6	28.7
pH (1: 10)	9.66	8.81
E.C. (1 : 10) dsm^{-1}	6.67	6.13
Total N %	1.0	1.0
O.M. %	35.2	45.6
Organic. Carbon	20.4	26.4
C/N	14.1	22.1

Randomized complete block design (RCBD) in split split plot arragement was followed where the two types of compost, the four levels of compost and the two biofertilizer and humic acid treatments occupied the whole plots, sub plot and sub sub plots, respectively. Therefore, the investigation consisted from 16 treatments. Each treatment was replicated three times, one vine per each.

During both season, the following parameters were recorded:

1- Leaf area (cm^2) (**Ahmed and Morsy, 1999**).
2- Main shoot length (cm.)
3- Pruning wood (kg) / vine/.
4- Cane thickness (cm.)
5- Chlorophylls a & b and total Chlorophylls (a & b) in the leaves (as mg/ 100 g. F.W.) in the fresh leaves (**Von- Wettstein, 1957 and Fadl and Ser El deen, 1978**).
6- Percentages of N, P and K in the petioles of the leaves located at the of opposite of the basal clusters (**Chapman and Pratt, 1987 and Balo *et al.,* 1988)** on dry weight basic .
7- Yield / vine expressed in weight (kg.) and number of clusters / vine.
8- Weight of cluster (g.)
9- Characteristics of the berries namely berry weight (g.), T.S.S.%, reducing sugars % **(A.O.A.C., 2000)**, total acidity % (as g. tartaric acid / 100 ml juice) **(A.O.A.C., 2000)** nitrate and nitrite (as ppm.) in the juice using method of **Ridnour – Lisa et al (2000).**
10- The Total counts of bacteria (cfu./g. soil) **(Cochran, 1950).**

Statistical analysis was done using New L.S.D. at 5% for comparing among the different treatment means **(Mead et al 1993)**.

RESULTS AND DISCUSSION

1- Vegetative growth characters

It is clear from the obtained data in **Tables (3 and 4)** that supplying the vines with compost II (40% cattle manure + 60% rice straw) was significantly superior than using compost I (Herbs and medicinal plants) in stimulating the leaf area, main shoot length, pruning weight and cane thickness during both seasons.

Fertilizing the vines with compost at 14 to 20 kg. / vine/ year as well as rock phosphate at 0.357 to 0.5 kg./ vine/ year and feldspar at 0.714 to 1.0 kg./ vine/ year significantly improved the four growth traits over the use of N, P and K as 100% mineral source alone. Increasing the levels of compost from 14 to 20 kg./ vine/ year, rock phosphate from 0.428 to 0.5 kg./ vine/ year and feldspar from 0.857 to 1.0 kg./ vine/ year was significantly followed by enhancing leaf area, main shoot length, pruning weight and cane thickness. Increasing the levels of compost from 16 to 20 kg. had meaningless promotion on these growth characters. The maximum values were recorded on the vines that fertilized with compost at 20 kg./ vine + rock phosphate at 0.5 kg./ vine and feldspar at 1.0 kg / vine / year .

Using mineral N, P and K at 60 , 60 and 120 g / vine plus the three biofertilizers namely (*Bacillus megatheium , Bacillus circulanse and Azotobacter chroococcum* + humic acid each at 10 ml./ vine/ year was significantly superior than using mineral N, P and K alone in enhancing these growth characters.

All the investigated interactions had significant effect on the four investigated growth characters. The maximum values were recorded on the vines that received mineral N, P and K at 60, 60 and 120 kg./ vine, respectively plus compost II at 20 kg./ vine + rock phosphate at 0. 5 kg./ vine + feldspar at 1.0 plus the three biofertilizers (*Bacillus megatheium, Bacillus circulanse and Azotobacter chroococcum*) and humic acid each at 10ml. / vine / year.

2- Total chlorophylls and percentages of N, P and K in the leaves

Data in **Tables (5 and 6)** clearly show that using compost II (40% cattle manure + 60% rice straw) significantly stimulated total chlorophylls as well as percentages of N, P and K in the leaves comparing with applying of compost I (Herbs and medical plant resides) during both seasons.

Using compost at 14 to 20 kg./ vine, rock phosphate at 0.357 to 0.5 kg./ vine and feldspar at 0.714 to 1.0 kg./ vine significantly enhanced total chlorophylls as well as percentages of N, P and K in the leaves relative to using mineral N, P and K at 60, 60 and 120 g./ vine respetively alone. The promotion was associated with increasing levels of compost at 14 to 20 kg./ vine, rock phosphate at 0.375 to 0.5 kg./ vine and feldspar from 0.714 to 1.0 kg./ vine. The maximum values were recorded on the vines that received compost at 20 kg./ vine, rock phosphate at 0.5 kg./ vine and feldspare at 1.0 kg./ vine. The untreated vines with these organic and slow release fertilizer treatments had the lowest values.

Using 60, 60 and 120 g./ vine mineral N, P and K, respectively besides all biofertilizers *(Bacillus megatheium, Bacillus circulanse and Azotobacter chroococcum)* and humic acid each at 10ml / vine / year significantly enhanced total chlorophylls as well as percentages of N, P and K in the leaves comparing with the application of mineral N, P and K alone. These results were true during both seasons.

The investigated interactions had significant effect on the four chemical constituents of the leaves. They were maximized in the vines that received mineral N, P and K at 60, 60 and 120 g./ vine, respectively plus compost II (40% cattle manure + 60% rice straw) at 20 kg./ vine , rock phosphate at 0.5 kg./ vine + feldspare at 1.0 kg./ vine, the three biofertilizers*(Bacillus megatheium, Bacillus circulanse and Azotobacter chroococcum)* and humic acid each at 10ml. / vine / year.

3- Yield and cluster weight

It is clear form the data in **Tables (7 and 8)** that fertilization of Superior seedless grapevines with compost II (40% cattle manure + 60% rice straw) significantly improved the yield expressed in weight and number of clusters / vine as well as cluster weight comparing to the use of compost I (Herbs and medical plant resides) during both seasons.

Application of compost at 14 to 20 kg./ vine besides rock phosphate at 0.375 to 0.5 kg./ vine and feldspare at 0.714 to 1.0 kg./ vine significantly was accompanied with improving the yield and cluster weight relative to the application of mineral N, P and K alone. The promotion was associated with increasing levels of compost from 14 to 20 kg./ vine, rock phosphate from 0.375 to 0.5 kg./ vine and feldspare from 0714 to 1.0 kg./ vine.

The maximum values were recorded on the vines that received compost at 20 kg./ vine plus rock phosphate at 0.5 kg./ vine and feldspar at 1.0 kg./ vine / year. But from economical point of view, it is advised to use compost at 16 kg./ vine + rock phosphate at 0.428 kg./ vine and feldspar at 0.857 kg./ vine.

Using mineral N, P and K fertilizers (60, 60 and 120 respectively) besides the three biofertilziers *(Bacillus megatheium, Bacillus circulanse and Azotobacter chroococcum)* and humic acid each at 10ml./ vine / year significantly was responsible for improving the yield and cluster weight relative to fertilizing the vines with mineral N, P and K alone.

Yield and cluster weight of Superior seedless grapevines were significantly improved due to using all combinations of mineral N, P and K, compost (I & II) , biofertilizers , slow release fertilizers and humic acid. The best results were obtained on the vines that received N, P and K in mineral at 60, 60 and 120 g./ vine , respectively, besides compost II (40% cattle manure + 60% rice straw) at 16 kg./ vine + + rock phosphate at 0.428 kg./ vine ,feldspar at 0.857 kg./ vine + the three biofertilizers (*Bacillus megatheium, Bacillus circulanse and Azotobacter chroococcum)* and humic acid each 10ml./ vine / year . Under such promised treatment the yield/ vine reached 12.5 and 13.6 kg during both seasons, respectively.

4- Physical and chemical characteristics of the berries

Data in **Tables (9 and 10)** clearly show that application of compost II (40% cattle manure + 60% rice straw) significantly, was very effective in improving quality of the berries in terms of increasing berry weight , T.S.S. and total sugars and decreasing the total acidity relative to use of compost I (Herbs and medical plant resides) during both seasons.

Using compost at 14 to 20 kg./ vine as well as rock phosphate at 0.375 to 0.5 kg / vine and feldspar at 0.714 to 1.0 kg./ vine significantly was favourable in improving quality of the berries than using mineral N, P and K alone. The promotion on fruit quality was related to increasing the levels of compost. and both the two slow release fertilizers namely rock phosphate and feldspar. The best findings in this respect were revealed with using compost at 20 kg./ vine + rock phosphate at 0.5 kg./ vine and feldspare at 1.0 kg./ vine/ year. The vines subjected to mineral N, P and K alone gave unacceptable quality parameters.

All the investigated interactions among the three studied factors had significant influence on quality of the berries. Supplying the vines with 60, N, 60, P and 120, K + compost II (40% cattle manure + 60% rice straw) at 20 kg./ vine + rock phosphate at 0.5 kg./ vine, feldspar at 1.0 kg./ vine/ year + the three biofertilizers (*Bacillus megatheium, Bacillus circulanse and Azotobacter chroococcum)* and humic acid each 10ml / vine / year gave the best results with regard to quality of the berries. The vines treated with mineral N, P and K plus compost I (Herbs and medical plant resides) gave unfavourable effects on fruit quality in 2013 and 2014 seasons.

5- Nitrate and nitrite in the juice

It is noticed from the obtained data in **Table (11)** that amending Superior seedless grapevines with compost II (40% cattle manure + 60% rice straw) significantly was accompanied with reducing both nitrate and nitrite in the juice rather than using compost I (Herbs and medical plant resides) during both seasons.

There was a gradual reduction on both nitrate and nitrite in the juice with increasing levels of compost, rock phosphate and feldspar. Significant difference on both nitrate and nitrite in the juice were observed among the vines that received compost and both the two slow release fertilizers and humic acid and those received mineral N, P and K alone.

Treating the vines with mineral N, P and K along with the three biofertilizers and humic acid was significantly favourable than using mineral N, P and K alone in reducing both nitrate and nitrite in the juice.

The best combination in producing the lowest values of nitrate and nitrite in the juice was the application of compost II at 20 kg./ vine + rock phosphate at 0.5 kg./ vine, feldspar at 1.0kg./ vine + the three biofertilizers (*Bacillus megatheium, Bacillus circulanse and Azotobacter chroococcum)* and humic acid each 10ml / vine / year.

6- Total counts of bacterial in the soil

Data in **Table (11)** obviously reveal that organic manuring with compost II (40% cattle manure + 60% rice straw) significantly enhanced the total counts of bacteria in the soil relative to using compost I (Herbs and medical plant resides).

There was a gradual promotion on the total counts of bacterial in the soil with increasing levels of compost, rock phosphate and feldspar. Using compost rock phosphate and feldspar at the higher levels gave the greatest values. The lowest values were recorded on the soil under vines received N, P and K in mineral form alone.

Using the three biofertilizers *(Bacillus megatheium, Bacillus circulanse and Azotobacter chroococcum)* and humic acid at 10ml./ vine in combined with N, P and K mineral form at 60 , 60 and 120 g./ vine , respectively caused a significant increase on the total number of bacteria in the soil relative to the application of N, P and K in mineral form alone. The maximum values of total number of bacteria in the soil was noticed in the treatment that received mineral N, P and K (60, 60 and 120 g./ vine of N, P and K respectively), compost II (40% cattle manure + 60% rice straw) at 20 kg/ vine + rock phosphate at 0.5 kg./ vine, feldspar at 1.0 kg./ vine ,the three biofertilizers *(Bacillus megatheium, Bacillus circulanse and Azotobacter chroococcum)* and humic acid each at 10ml./ vine/ year. The treatment included the application of mineral N, P and K and compost I (Herbs and medical plant resides). alone gave the lowest values. These results were true during both seasons.

DISCUSSION

The investigated beneficial effects of organic and biofertilization on growth and fruiting of Superior seedless grapevines might be attributed to their positive action on lowering soil pH and salinity and enhancing soil fertility, cation exchange capacity, higher, content of B vitamins and natural hormones and root development (**Nijjar, 1985 and Kannaiyan, 2002**). The continuous release of P and K during all plan t stages in response to application of rock phosphate and feldspar especially when applied with biofertilizers could explain the present results. These treatments also were responsible for enhancing the total number of bacterial in the soil that could reflect in enhancing the decomposition of insoluble nutrients to soluble ones (**Nijjar, 1985**).

CONCLUSION

For promoting yield and quality, it is suggested to supply Superior seedless grapevines with N, P and K at 60, 60 and 120 g. / vine respictivily besides compost II (40% cattle manure + 60% rice straw) at 16 kg/ vine + rock phosphate at 0.428 kg./ vine, fedlspare at 0.857 kg./ vine ,the three biofertilizers *(Bacillus megatheium, Bacillus circulanse and Azotobacter chroococcum)* and humic acid each at 10ml./ vine/ year.

REFERENCES

Abada, M.A.M., Ibrahim-Asmaa, A. and Bondok-Sawsan, A. 2010. How to reduce problems of soil and irrigation water salinity in Superior vineyards? **Minufiya. Agric. Res. 35, 4(2), 1977- 1497.**

Abd El-aal, A.H., Basma-Selim, M. and Ghada-Shaker, S.H. 2007, Response of Superior grapevines to application of filter mud, compost El Nile and green manure. **J. Agric. Sci. Mansoura Univ., 32(12), 10300-10309.**

Abd El-Aziz, Y.Z. 2011, Response of Thompson seedless .grapevines to application of organic fertilizer humic acid and some bio fertilizers. Ph.D. Thesis Fac. of Agric. Minia Univ. Egypt.

Abd El-Hady, A.M. 2003. Response of Flame Seedless vines to application of some biofertilizers. **Minia J. of Agric. Res. & Develop. 23(4), 667-680.**

Abd El-Hameed, H.M., Abada, M.A. and Seleem-Basma, M. 2010. Reducing inorganic N fertilizer partially by using yeast, seaweed and farmyard manure extracts in Flame seedless grapevines. Minia 2nd Conf. Agric. Environ. Sci. **pp. 81- 89.**

Abd El-Hameed, N.Sh., Selem, M.Se., Ghobrial, G.F. and Khairy, A. 2004. Effect of different nitrogen doses and bio-fertilizer application on yield and quality of "Crimson seedless" grapes. **Institute of Environmental, 8(3), 837-862.**

Ahmed, F.F. and Ibrahim-Asmaa, A. 2009. Reducing inorganic N fertilizer in Thompson seedless vineyard through application of EM and Seaweed extract. Minia J. of Agric. Res. & Develop. 29(3), 355- 369.

Ahmed, F.F. and Morsy, M.H. 1999. A new methods for measuring leaf area in different fruit species. **Minia, J. of Agric. Res., Develop. 19, 97-105.**

Ahmed, F.F., El-Sayed, H.A. and Shoeib, M.M. 2003. Effect of bio and organic source of N as a partial substitute for chemical fertilizer on bud behaviour, growth and fruiting of Flame seedless grapevines. **Minia J. of Agric. Res. & Develop. 23(3), 529-546.**

Allam- Aida, M.A., Ahmed, F.F., El-Hefnawy, N.N., ElHewety, M.A. and El-Khafagy, H.A. 2012. Impact of inorganic N and compost enriched with some bacterial strains on fruiting of Superior and Flame seedless grapevines as well as nitrogenase activity in the soil. **Minia J. of Agric. Res. & Develop. 32(1), 115-130.**

Association of Official Agricultural Chemists 2000. Official Methods of Analysis (A.O.A.C), 12th Ed., Benjamin Franklin Station, Washington D.Q, U.S.A. pp. 490-510.

Balo, E., Prilesszky, G., Happ, I., Kaholami, M. and Vega, L. 1988. Soil improvement and the use of leaf analysis for forecasting nutrient requirements of grapes. **Potash Review (Subject 9, 2nd suite. No. 61: 1-5).**

Black, G.A., Evans, D.D., Ersminger, L.E., White, J.L. and Dark, F.E. 1965. Methods of Soil Analysis. Amer. Soc. Agron. Inc. Bull. Medison, Wisconsin, U.S.A. pp. 891-1400.

Chapman, H.D. and Pratt, P.E. 1987. Methods of Analysis for Soil, Plant and Water. Univ. California, Div. Agric. Sci. 1, 150.

Cochran, W.G. 1950. Estimation of bacterial densities by means of the most probable number. **Biometrics 6, 105-116.**

Davis, G. and Ghabbour, E.A. 1998. Humic substances, structure properties and uses. **Royal Soc. of Chemistry, Cambridge pp. 10-15.**

El-Khafagy, H.A. 2006. Effect of some organic and biofertilizer treatments on growth and productivity of Thompson seedless grapevines in reclimated areas. M.Sc. Thesis. Fac. of Agric. Minia Univ., Egypt.

El-Wany, A.R. 2015. Response of Thompson seedless, grapevines to application of E.M. and fulvic acid as a partial replacement of inorganic N fertilizers. M.Sc. Thesis, Faculty of Agric. Minia Univ. Egypt.

Fadl, M.S. and Ser El-Deen, S.A. 1978. Effect of N Benzyl adenine on photosynthesis pigments total sugars on olive seedling growth under saline condition. Res. Bull. No. 843, Fac. Agric. Ain shams Univ., Cairo, Egypt.

Farag, S.G. 2006. Minimizing mineral fertilizers in grapevines farms to the chemical residuals in grapes. M.Sc. Thesis, Institute of Environmental Studies Research, Ain Shams Univ. Egypt.

Kannaiyan, S. 2002. Biotechnology of Biofertilizers. Alpha Science International Ltd Panpabourne England, **I275 p.**

Masoud, S.E.Y. 2008. Attempts for alleviating the adverse effects of soil salinity on growth and fruiting of Superior grapevines. M.Sc. Thesis, Fac. of Agric. Minia Univ., Egypt.

Mead, R., Curow, R.N. and Harted, A.M. 1993. Statistical Methods in Agricultural Biology. 2nd Ed. Chapman & Hall, London. **pp. 50 - 70.**

Mekawy, A.Y.H. 2012. Attempts for improving yield quantitively and qualitatively of Thompson seedless grapevines by application of some antioxidants with humic acid and farmyard manure extract. Ph.D. Thesis Fac. of Agric. Minia Univ., Egypt.

Nijjar, G.S. 1985. Nutrition of Fruit Trees. Mrs Usha Raj. Kumar, for Kalyani Publishers, New Delhi, India, **pp. 283- 302.**

Rdinour-Lisa, A., Sim-Julia, E., Michael, A.H., David, A.W., Sean, M.M., Garry, R.B. and Douglas, R.S. 2000. A spectrophotometric method for the direct detection and quantitation of nitrite oxide, nitrite and nitrate in cell culture media **Ana Biochem. 281, 223- 229.**

Saleh, M.M.S., El-Ashry, S. and Gomaa, A.M. 2006. Performance of Thompson seedless grapevines as influenced by organic fertilizer, humic acid and biofertilizers under sandy soil conditions. **Res. J. of Agric. and Biological Sci. 2(6), 467-741.**

Shaaban, A.S.A. 2014. Effect of organic fertilization on growth and quality of Superior grapevines. Ph. D Thesis Fac. of Agric. Cairo. Univ., Egypt.

Von-Wettstein, D.V.C. 1957. Clatale and der Sumbmikro Skopisne Formwechsel de Plastids. Experimental Cell Research, 12 -427.

Weaver, R.J. 1976. Grape Growing. A Wiley Interscience Publication John Wiley& Davis, New York, London, Sydney, Tronto. **pp. 160-175.**

Wilde, S.A., Corey, R.B., Layer, J.G. and Voigt, G.K. 1985. Soils and Plant Analysis for Tree Culture. Oxford and IBH publishing Co., New Delhi, India.