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"EFFECT OF SOME BIO- AND ORGANIC FERTILIZERS AND ANTIOXIDANTS ON GROWTH AND FRUITING OF FLAME SEED LESS GRAPEVINES UNDER UPPER EGYPT CONDITIONS"

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SUMMARY AND CONCLUSION

The present investigation was carried out in three successive seasons of 2018, 2019 and 2020 on Flame Seedless grapevines. The vines were grown in the experimental vineyard of Research Station Agriculture, El-Matanah, Esna, Luxor, Egypt, where the soil is clay.

The vines were 10 years old at the starting of this experiment and spaced at 2x3 meters apart. 168 healthy with no visual nutrients deficiency symptoms, nearly uniform in shape, size and productivity were chosen and devoted to achieve this study. The chosen vines were received the usual agriculture practices that are used in the vineyard including irrigation and pest control. The vines were trained according to the T. shape and pruned during the second week of December by leaving 15 fruiting spurs with 4 buds each plus six replacement spurs with 2 buds each.

The treatments set up in completely randomized block design (CRBD) in a split-plot arrangement with three replicates, two vine each. Factor A is an antioxidant and factor B is the fertilization treatments.

The first factor (A) involved four antioxidants spray as follows:

A_1- Spraying with distilled water (check treatment).

A_2- Spraying with vitamin B_{12} (V. B_{12} at 250 ppm).

A_3- Spraying with citric acid at 250 ppm.

A_4- Spraying ascorbic acid at 250 ppm.

Solution of vitamin B_{12}, citric acid and ascorbic acid concentration were prepared with distilled water and then sprayed thrice after berry set, one and two months later.

The second factor (B) involved seven treatments of nitrogen fertilization as follows:

B_1- Application of the recommended dose of nitrogen (RDN), 80 g N/vine/year (240 g ammonium nitrate) as 100% mineral N form.

B_2- Application of the RDN as 50% mineral and 50% yeast as bio-fertilizers.

B_3- Application of the RDN as 50% mineral and 50% nitroben.

B_4- Application of the RDN as 50% mineral and 50% algae extracts as natural fertilizers.

B_5- Application of the RDN as 25% mineral plus 25% organic and 50% yeast.

B_6- Application of the RDN as 25% mineral plus 25% organic and 50 nitroben.

B_7- Application of the RDN as 25% mineral plus 25% organic and 50% algae extracts as natural fertilizer.

The organic fertilizer (compost 4.9% N) was added once at first week of February. The mineral nitrogen source was ammonium nitrate (33.5% N) and it was applied at three times: growth start, immediately after berry set and at two month later. Nitroben and yeast as bio-fertilizers and algae extracts were added in two equal batches at the growth start and one month later. Nitroben is a bio-fertilizer which contains nitrogen fixing bacteria. Algae extracts which contents macronutrients, micronutrients, amino acids, vitamins and plants hormones, whereas yeast contains a large amount of mineral, proteins, vitamin B and cytokinins.

The following parameters were determined to evaluate the effect of different treatments on growth and nutrient status as well as yield, cluster and berry traits.

1- Some vegetative growth parameters.
2- Leaf nutritional status.
3- Yield components.
4- Cluster and berry characteristic.

The results are obtained during the course of manuscript will be demonstrated as follow:

1- Effect of organic and bio-fertilizers as well as antioxidant on vegetative growth and leaf nutrient contents:

1.1- Shoot length and ripening and pruning weight of wood:

Concerning the effect of organic and bio-fertilization application, the results indicated that shoot length, wood ripening % and pruning wood weight were significantly affected due to use different organic and bio-fertilization (Nitroben & yeast) program used. Using required N via 50 or 25% of recommended dose of nitrogen (RDN) as mineral-N along with 50% of organic or bio (double form), as well as 25% mineral combined 25% organic plus 50% bio (triple form) significantly increased the shoot length, annual pruning wood weight and wood ripening compared to using RDN at 100% mineral alone. The promotion on such traits was associated with decreasing the applied level of mineral-N from 50 to 25%.

The maximum values of shoot length wood ripening and pruning wood weight were recorded on the vines that fertilized with the required N as 50% mineral-N along 50% algae (double form) or 25% mineral-N plus, organic

and 50% algae (triple form). On other world, using algae in the fertilization program is more effective in improving the growth traits, where gave the highest values of the studied vegetative growth traits. On other hand, the lowest values of such growth traits were recorded on vines that fertilized with 100% mineral-N (check treatment). No significant differences were found due to fertilize with double form (50% mineral-N plus 50% whatever, bio or organic) or triple form (25% mineral-N plus 25% organic and 50% bio).

Since the increase in weight of pruning wood could be an indicator for the vine vigor during the previous season, it might refer also to the possibility of high productive ability of the vine during the following season. It could be concluded that all applied level of organic and bio-fertilization program used in the vineyard indirectly and positively effected on the grapevine growth and vigor.

As, regard to the effect antioxidant spraying, the data showed that the shoot length, wood ripening and pruning wood weight were significantly affected by various sources of antioxidant spraying. Ascorbic acid, citric acid and vitamin B_{12} (V. B_{12}) spraying significantly increased the shoot length wood ripening % and weight of pruning wood compared to sprayed water ones (control). Using ascorbic acid gave the highest values of these traits compared to citric acid or V.B_{12} spraying. No significant differences were recorded due to spray any antioxidant compared to others.

In addition, data indicated that the shoot length, wood ripening % and pruning wood weight significantly responded to the interaction between the three studied factors. The highest values were obtained in vines that fertilized with 50% RDN via mineral-N plus 50% algae combined ascorbic acid spraying.

The highest recorded shoot length, wood ripening % and pruning wood weight due to fertilize with 50% mineral-N and 50% algae combined ascorbic acid spraying.

No significant differences due to fertilize with either double or triple forms along spray with either, V.B_{12}, citric acid or ascorbic acid.

As, an overview, the results declared that the combination effects significantly increased the shoot growth traits than increment due to individual effects of either fertilization treatments or antioxidants spraying. Such findings might be due to the organic and bio-fertilization technique improving the availability of nutrients in the rhizosphere, that lead to increasing the uptake and induce improving the effect of organic and bio-form in growth and vigour of grapevines.

It could be concluded that used 50 to 75% of RDN via organic and bio-form combined citric acid, ascorbic acid or vitamin B_{12} spraying was beneficial improvement of growth and vigour of vines. In addition, it reduces the need mineral fertilizer and decrease the cost of production as well as was very useful in reducing environmental pollution.

1.2- Leaf characteristics:

Leaf area and it chlorophyll and carotenoids contents were significantly improved due to use different organic and bio-fertilization program. Using fertilization program at either 50 or 25% out of recommended dose of nitrogen (RDN) via mineral-N with 50% organic or bio (double form), as well as 25% mineral-N plus 25% organic and 50% bio (triple form) significantly increased the leaf area chlorophyll contents and total carotenoids compared to using RDN at 100% mineral alone. The promotion on such traits was associated with reduction the applied level of mineral-N from 50% to 25%.

The maximum values of these studied leaf traits were recorded on the vines that fertilized with the required N as 50% mineral-N along 50% algae (double form) or 25% mineral-N plus 25% organic and 50% algae (triple form). On other hand, the lowest values of such leaf traits were recorded on vines that fertilized with 100% mineral-N (check treatment).

No significant differences were found due to fertilize by double form (50% mineral-N plus either 50 bio or organic) or triple form (25% mineral-N plus 25% organic and 50% bio-form).

The leaf area and their chemical composition were significantly affected by various sources of antioxidant spraying. Vitamin B_{12}, ascorbic acid and citric acid spraying as a source for antioxidant significantly increased the leaf area, chlorophyll contents and total carotenoids compared to spray ones (control). Using ascorbic acid gave the highest values of these traits compared to citric acid or V.B_{12} spraying.

No significant differences were recorded due to spray any antioxidant compared to others.

The leaf area, chlorophyll contents and total carotenoids significantly responded to the interaction between the three studied factors. The highest values were obtained in vines that fertilized with 50% RDN via mineral-N plus 50% algae combined ascorbic acid spraying.

No significant differences due to fertilize with either double or triple forms along spray with V.B_{12}, citric acid or ascorbic acid.

As, an overview, the results declared that the combination effects significantly increased the leaf traits than increment due to individual effects of either fertilization treatments or antioxidants spraying. Such findings might be due to the organic and bio-fertilization technique improving the availability of nutrients in the rhizosphere, that lead to increasing the uptake and induce improving the effect of organic and bio-form in growth and vigour of grapevines.

It could be concluded that used 50 to 75% of RDN via organic and bio-form combined ascorbic acid, citric acid or vitamin B_{12} spraying was beneficial improvement of growth and vigour of vines. In addition, it reduces the need mineral fertilizer and decreases the cost of production as well as was very useful in reducing environmental pollution.

1.3- Leaf nutritional status:

The leaf N, P and K contents were significantly affected by various organic and bio-fertilization program. Using fertilization program at either 50 or 25% out of recommended dose of nitrogen (RDN) via mineral-N with 50% organic or bio-form (double form), as well as 25% mineral-N plus 25% organic and 50% bio (triple form) significantly increased the percentage N, P and K in leaves compared to using RDN at 100% mineral alone. The promotion on such leaf nutrients was associated with decreasing the applied level of mineral-N from 50% to 25%.

The maximum values of such leaf nutrients, N, P and K were recorded on the vines that fertilized with double form (50% mineral-N plus 50% yeast or algae) or triple form (25% mineral-N plus 25% organic and 50 algae). On other meaning that used algae extract in fertilization program is very effective in increasing the content of nutrients in leaves, since gave the highest values of N, P and K contents in leaves compared other used application leaf nutrients. On other hand, the lowest values of leaf N, P and K contents were recorded on vines that fertilized with 100% mineral-N (check treatment).

The leaf contents of N, P and K were significantly affected by various sources of antioxidant spraying. Ascorbic acid, citric acid and vitamin B_{12} spraying significantly increased the leaf N, P and K percentages compared to spray water ones (control). Using ascorbic acid gave the highest values of these nutrients percentage leaves compared to citric acid or V.B_{12} spraying. No significant differences were recorded due to spray any antioxidant compared to others.

All combination of fertilized via double or triple forms with antioxidants spraying significantly improved the percentage of N, P and K in

leaves compared to check treatment. The highest values were obtained in vines that fertilized with 50% RDN via mineral-N and 50% algae combined ascorbic acid spraying (A_4B_4).

No significant differences due to fertilize with double or triple form along spray with ascorbic acid citric acid or vitamin B_{12}.

As, an overview, the results declared that the combination effects significantly increased the leaf nutritional status than increment due to individual effects of either fertilization treatments or antioxidants spraying. Such findings might be due to the organic and bio-fertilization technique improving the availability of nutrients in the rhizosphere, that lead to increasing the uptake and induce an increase the mineral nutrition on grape leaves.

It could be concluded that used 50 to 75% of RDN via organic and bio-form combined ascorbic acid or citric acid spraying was beneficial improvement of growth and vigour of vines. In addition, it reduces the need mineral fertilizer and decreases the cost of production as well as was very useful in reducing environmental pollution.

2- Effect of organic and bio-fertilization as well as antioxidant on yield components:

Born cluster on the vines insignificantly changed in the first season of study with using any treatment compared to check one (control).

Cluster number and yield (kg) per vine were significantly affected by different organic and bio-fertilization program used. Using nitrogen fertilization as double or triple form program significantly increased the clusters number and yield/vine compared to using RDN at 100% mineral alone during three studied season. The promotion on yield components (clusters number & yield/vine) were associated with decreasing the applied level of mineral-N from 50% to 25%.

The maximum values of number and yield/vine were detected on the vines that fertilized with the required N as 50% mineral-N along 50% algae (double form) or 25% mineral-N plus 25% organic and 50% algae (triple-form). On other hand, the lowest values of yield components were recorded on vines that fertilized with 100% mineral-N (check treatment).

Then, the increment percentage of yield/vine due to double form (50% mineral-N and 50% algae) or triple form (25% mineral-N plus 25% organic and 50% algae were attained (7.39 & 7.39), (14.26 & 12.62) and (15.54 & 12.83%) compared to use 100% via mineral-N only.

No significant differences were found due to fertilize with double form (50% mineral-N plus 50% whatever, bio or organic) or triple form (25% mineral-N plus 25% organic and 50% bio).

Such increment of yield/vine due to fertilize via double or triple form of fertilization mainly for increasing the clusters number/vine and cluster weight as result in improving the flowering and berry set.

The clusters number and yield/vine were significantly affected by various sources of antioxidant spraying. Ascorbic acid, citric acid and vitamin B_{12} (V. B_{12}) spraying significantly increased the clusters number and yield/vine compared to sprayed water (control). Using ascorbic acid gave the highest values of clusters number and yield/vine compared to citric acid or V.B_{12} spraying.

No significant differences were recorded due to spray any antioxidant compared to others.

Such increase in the yield components due to spray with antioxidants could be due for stimulation effects of nutritional status of the vines in favor of forming more productive buds. The previous merits of antioxidants on growth and vine nutritional status supported and gave good evidence to improve effect of the yield components.

It could be concluded that all the antioxidant used in the vineyard have indirectly and positively effected of grapevine productivity.

The yield components significantly responded to the interaction between the two studied factors. The highest values were obtained in vines that fertilized with triple form (25% mineral-N plus 25% organic and 50% algae) combined ascorbic acid spraying compared to other combinations.

No significant differences due to fertilize via double or triple form along spray with ascorbic acid or citric acid.

As, an overview, the results declared that the combination effects significantly increased the cluster number and yield/vine than increment due to individual effects of either fertilization treatments or antioxidants spraying. Such findings might be due to the organic and bio-fertilization technique improving the availability of nutrients in the rhizosphere, that lead to increasing the uptake and induce improving in growth and productivity of grapevines.

So, it could be concluded that used 50% to 75% via organic and bio-form combined ascorbic acid, citric acid or Vitamin B_{12} spraying was beneficial improvement of vines productivity. In addition, it reduce the need

mineral fertilizer and decrease the cost of production as well as was very useful in reducing environmental pollution.

3- Effect of organic and bio-fertilizers as well as antioxidants on cluster attributes:

Using required N via 50 or 90% at either 50 or 25% out of recommended dose of nitrogen (RDN) along with 50% organic or bio (double form) or 25% mineral-N plus 25% organic and 50% bio (triple form) significantly improved the cluster traits compared to using RDN at 100% mineral alone. The promotion on such cluster traits was associated with decreasing the applied level of mineral-N from 50% to 25%.

The maximum values of cluster weight, cluster length and berries number/cluster and least value of cluster compactness coefficient were recorded on the vines that fertilized with the required N as 50% mineral-N along 50% algae (double form) or 25% mineral-N plus 25% algae and 50% algae (triple form). On other hand, the lowest values of such cluster attributes were recorded on vines that fertilized with 100% mineral-N (check treatment).

No significant differences were found due to fertilize by any double or triple form with any level of mineral-N.

The cluster weight and its length, as well as berries number and cluster compactness coefficient were significantly affected by various sources of antioxidant spraying. Ascorbic acid, citric acid and $V.B_{12}$ spraying significantly increased the weight and length of cluster compared to sprayed water ones (control). Using ascorbic acid gave the highest values of these traits compared to citric acid or $V.B_{12}$ spraying. Also, antioxidant spraying had insignificantly effected on berries number per cluster and consequently significantly decreased the cluster compactness coefficient compared to sprayed with water (control).

No significant differences were recorded due to spray any antioxidant compared to others.

It could be concluded that all the antioxidant used in the vineyard have indirectly and positively effected of cluster traits. This improvement in the cluster attributes might be due to the nutritional balance and increased the availability and uptake of certain plant nutrients which stimulated the photosynthesis, plant growth promoters and protein synthesis and carbohydrate formation.

The cluster characteristics significantly responded to the interaction between the two studied factors. The highest cluster weight values were

obtained in vines that fertilized with 50% RDN via mineral-N plus 50% algae or 25% mineral-N plus 25% organic and 50% algae combined ascorbic acid spraying.

No significant differences due to fertilize with double form or triple form along spray with ascorbic acid, citric acid or vitamin B_{12}.

As, an overview, the results declared that the combination effects significantly increased the cluster weight and decreased the cluster compactness coefficient than increment or decrement due to individual effects of either fertilization treatments or antioxidants spraying.

4- Effect of organic and bio-fertilization as well as antioxidant on some berry quality:

Berry weight total soluble solids, titratable acid (as tartaric acid) reducing sugars and anthocyanin contents were significantly affected as the fertilization by organic and bio-form program used. Using fertilization program at either double form (50% mineral-N and 50% organic or bio-form) or triple form (25% mineral-N plus 25% organic and 50% bio) significantly increased the berry weight and total soluble solids (TSS) and TSS/acid ratio, as well as reducing sugars and anthocyanin contents and significantly decreased total acidity compared to using RDN at 100% mineral-N only (check treatment). The promotion on such berry characteristics was associated with present algae in fertilization program.

It could be simply to see from data that soluble soil contents were equivalent to reducing sugars and TSS/acid ratio and reversed current with total acidity.

The maximum values of these physiochemical properties except total acidity (least value) were recorded on the vines that fertilized with the RDN via 50% mineral-N along 50% algae (double form) or 25% mineral-N plus 25% organic and 50% algae (triple form). On other hand, the minimum values of then except total acidity (highest value) were recorded on the vines that fertilized with 100% mineral-N (check treatment). No significant differences were found due to fertilize double form (50% mineral-N plus 50% whatever bio organic) or triple form (25% mineral-N plus 25% organic and 50% bio).

Such increasing the berry weight, TSS, TSS/acid ratio, reducing sugar and anthocyanin content and decreasing the total acidity due to organic and bio-form combined with mineral-N could be attributed to activate the synthesis of carbohydrates and proteins which enhances cell division and elongation as well as enhances the fruit maturity. The money wise evaluation

of these application programs was in favor of 25% organic and 50% bio or algae of RDN via bio-form. Such programs are very important in vine berry production since the advance of berry maturity and increase the berry weight and size lead to an increase in marketable yield.

The berry weight, TSS, TSS/acid ratio, reducing sugar and anthocyanin contents and significantly increased due to ascorbic acid, citric acid or vitamin B_{12} spraying compared to unsprayed ones. On other hand, the total acidity significantly decreased due to spray the vines with ascorbic acid, citric acid or vitamin B_{12} compared to water sprayed (check treatment). The highest values of berry weight, were recorded due to ascorbic acid spraying compared to other treatments. On other hand, the least values of these berry traits detected on vines that water sprayed ones (check treatment A_1). No significant differences were found due to spraying compared to ascorbic acid, citric acid or V.B_{12} spraying.

Also, antioxidant spraying significantly increased total soluble solids, TSS/acid ratio, reducing sugars and anthocyanin and significantly decreased total acidity compared to water sprayed ones. The highest values of TSS, TSS/acid ratio, and reducing sugars and anthocyanin content and least values of total acidity were recorded due to ascorbic acid spraying compared to other treatments. On other side, the least values of TSS, TSS/acid ratio, reducing sugars and anthocyanin content and highest value of total acidity were recorded on berry from vines that water sprayed ones (check treatment). No significance differences were found due to ascorbic acid spraying compared to citric acid or V.B_{12} spraying.

Contrarily, all antioxidants spraying significantly decreased total acidity compared to water sprayed ones (check treatment). The least value was recorded on berries from vines that ascorbic acid spraying compared to other treatment. On other side, the highest value was found due to water sprayed ones.

It could be concluded that all the antioxidant used in the vineyard have indirectly and positively effected of grape berry quality. Since the antioxidant had more effective in enhancing the translocation of photosynthesis products and carbohydrates to induce hastened of berry maturation and improving the berry properties. Thus, it could be concluded that sprayed with ascorbic acid were more effective in improving the berry properties.

All combination of organic and bio-form 50-75% plus 50-25% mineral as well as ascorbic and citric acid or vitamin B_{12} spraying significantly increased weight of berry, total soluble solids and TSS/acid ratio as well as reducing sugar and anthocyanin content and significantly reduced titratable

acidity, compared to use mineral form and water sprayed ones (check treatment).

The highest values of these berry quality parameters except total acidity (least) recorded on vines that received double form (50% mineral-N plus 50% algae) or triple form (25% mineral-N plus 25% organic and 50% algae) combined with ascorbic acid. Whereas the minimum values of these traits except total acidity (highest) were detected on vines that fertilized with RDN via 100% mineral and water sprayed ones.

Moreover, all combination double or triple form of fertilization singly or together plus ascorbic acid, citric acid or $V.B_{12}$ spraying was more effective in improving the fruit quality compared to combined of mineral-N with water sprayed ones.

Moreover, no significant differences due to use double or triple form 50% mineral with 50% bio-form at any formats combined with ascorbic acid, citric acid or $V.B_{12}$ spraying. Such findings might be due to the organic and bio-fertilizers improving the availability of nutrients in the rhizosphere that lead to increase their uptake and induce improving the berry quality and advanced the berry maturation. These findings emphasized that growth, vigor and fruiting depend upon food material and carbohydrates which manufactured in leaves and nutritional status of vine improved as results of best organic and bio-fertilization and antioxidant treatments.

So, it can be concluded that using 50-75% of RDN via organic and bio-form plus 50-25% mineral-N singly or together accompanied with ascorbic acid spraying as a source of antioxidants were more effective in improving the berry weight, as well as total soluble solids, TSS/acid ratio, reducing sugar and anthocyanin content reduced the titratable acidity, hence improved the berry properties.

Conclusion:

On the light of previous results, it could be concluded that fertilizing by 50-75 organic and bio form plus 50-25% mineral accompanied with ascorbic acid or citric as a source of antioxidants fertilization enhancing growth and nutritional status of Flame Seedless grapevines. In addition, they increased the yield and improved the cluster and berry traits. Moreover, they improved the soil fertility and minimized the production cost and the environments pollution which could be occurred by excess of chemical fertilizers used.