TABLE GRAPE
COLOR PROTOCOL

MUGAVERO

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Web
www.mugavero.it

Email
info@mugavero.it

Telephon
+39 091 8533100

Offices
Corso Umberto e Margherita 1/B
termini Imerese (PA)
90018 - Italy

Production Plant
Zona Industriale
Termini Imerese (PA)
90018 -Italy

A Look at the Issues with Table Grapes

The vegetative-productive balance of the vine is the basis for the best productive result: balanced fertilization, targeted summer pruning and correct irrigation schedules are the prerequisites for obtaining a quality product in terms of ripening and coloring of the grapes.
Excessive vigor of the vineyard or using intensive cultivation techniques, can have a negative impact on the ripening time of the grapes. An increasingly and unpredictable climate can cause high air temperatures in covered protective structures (greenhouse or plastic covered vineyards for early or late ripening) leads to a negative repercussion on the physiology of the plant; the grower is not always able to meet the crop's water needs through careful irrigation management, resulting in water or evapotranspiration stress. In these cases, problems of only partial lignification of the fruiting shoot can occur leading to a final product with "quality" parameters that do not meet market requirements.

Picture 1. Uniformity of coloring of the cv Crimson seedless bunch on a well-lignified fruiting shoot on September 8 2022, in the area of Turi (BA); Picture 2. Red grape in "pre-veraison" phase (BBCH 81).

The Coloring Protocol

To properly initiate the ripening and coloring processes of table grapes, it is essential to have various factors that, working in synergy together, ensure an increase in sugars and, more importantly a decrease in acids within the berries. The coloring of the grape is one of the most important quality parameters at the time of harvest. Insufficient or uneven coloring has negative repercussions on the final market of the product, especially in relation to the timing and number of harvests that it is necessary to be carry out. The Mugavero protocol, specifically for coloring, was developed after several years of technical experience and subsequent validation by public and private research entities; the protocol allows us to standardize the ripening process of the fruiting shoot, resulting in better coloring of the bunch while maintaining the qualitative characteristics of the grapes (Picture 1). The color protocol is applied starting from the pre-veraison phase (BBCH 81 scale) or when the berry begins to change color (Picture 2);

The protocol initially involves a foliar application with a resistance inducer, **STATIA** combined with a fertigation with **NIGER 700** and **UPPER GROW**, respectively a water-soluble fertilizer and a biostimulant; the treatment must be repeated after a week.

Doses and timing of the treatment can vary depending on the varietal needs and the degree of lignification of the plant.

Table 1. Schematic representation of the coloring protocol - BBCH - descriptive phenological scale for table grapes.

BBCH	81 BEGINNING OF VERAISON	83 FULL VERAISON	85 RIPENING 20%	85 RIPENING 50%	89 RIPENING 80%
Foliar application	STATIA	STATIA	STATIA	STATIA	MATURAU
			UPPER GROW	UPPER GROW	
Fertigation	UPPER GROW	UPPER GROW		UPPER GROW	
	NIGER 700	NIGER 700		NIGER 700	

Foliar application
Fertigation

BIOSTIMULANTS
RESISTANCE INDUCERS
WATER-SOLUBLE

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Abstract / Table Grape Protocol

Pictures 3 and 4. Application of the coloring protocol on red seedless grapes cv TIMCO. Detail of the coloring on the treated bunch (LEFT) and untreated (RIGHT).

At a more advanced stage, **STATIA** and **UPPER GROW** are applied foliarly in two treatments, and a third fertigation is repeated to give the plant the correct boost, accelerate the "ripening" processes of the grapes and compensate for some fundamental deficits of the bunch (Pictures 3 and 4). In the final phase, when the bunch is at 80% of ripeness, a foliar application with **MATURAU**, a biostimulant designed to uniform the coloring and uniformity of the grapes, is scheduled.

Applying the entire protocol ensures excellent coloring results even on the most problematic grapes (Pictures 5 and 6). The qualitative aspects do not stop at the uniformity of color: the data in fact confirm an organoleptic and sanitary quality of the treated grapes even in the post-harvest period, which are certainly fundamental aspects for the table grape market.

Pictures 5 and 6. Detail of the coloring of cv Supernova seedless on grapes treated with the Mugavero coloring pro tocol (LEFT) and untreated (RIGHT).

Two-year study (2022-23) on red table grape Crimson seedless cultivar and results of Maturau application(1)

In the two-year period 2022-2023, a specific study on the coloring of Crimson seedless grapes was conducted; this variety of red table grapes, although not newly introduced, continues to stand out in international markets for its sweet flavor, crunchy texture, climatic adaptability, and disease resistance.
The table grape vineyard, in its ninth year of planting, is located in the Agrigento area (Lat. 37°22'46" N Long. 13°47'12" E) with a spacing of 2.8 x 2.8 m and rootstock 140 Ru. The climatic parameters such as humidity (%) and air temperature (°C) were monitored. Two factors were studied: the treatment and the color of the berries. The colorimetric parameters Hue angle (H°), Lightness (L), Color (C) were determined to define the CIELAB color space and subsequently to calculate the Color Index for Red Grapes (CIRG), an indicator of the quality of red grapes. Additionally, the water status of the crop, the qualitative parameters of the bunch and berry, and the technological maturity were also evaluated. The Texture Profile Analysis was used to derive the "consistency profiles" of the grapes at harvest and on refrigerated samples. Finally, the shelf-life of the grapes was evaluated with reference to the total soluble solids (TSS)/titratable acidity (TA) ratio, expressed in Brix° and g/L of tartaric acid, respectively.

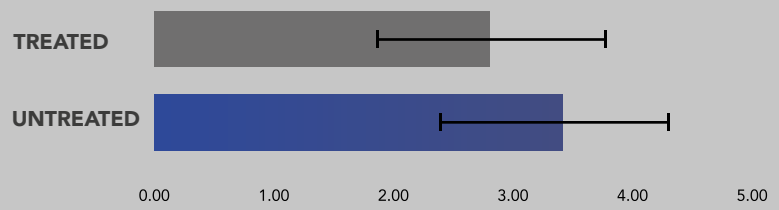
Table 2. Timing of application and quantities of products applied on red grape cv Crimson seedless.

DATA	14 JULY	30 JULY	9 AUGUST	20 AUGUST	9 SEPTEMBER
RATES per ha	STATIA 0,5 L	STATIA 0,5 L	STATIA 0,5 L	STATIA 0,5 L	MATURAU 0,5 L
			UPPER GROW 0,25L	UPPER GROW 0,25L	
RATES per ha	UPPER GROW 0,5 L	UPPER GROW 0,5 L		UPPER GROW 0,5 L	
	NIGER 700 5Kg	NIGER 700 3Kg		NIGER 700 3Kg	

In the first year 2022, the foliar treatment with **MATURAU** to improve the color was carried out on September 5th with a single application when more than 60% of the bunches were colored; Three surveys were conducted on a weekly basis on September 9th, 16th, and 22nd.

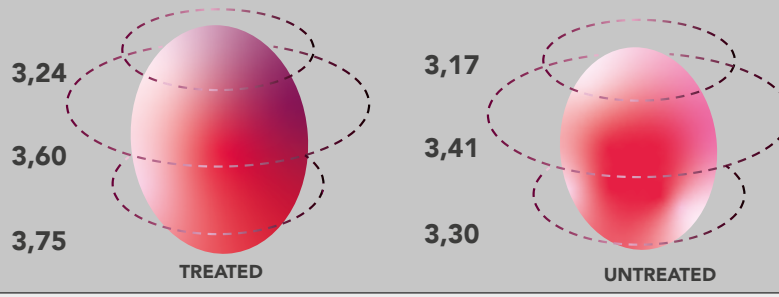
The application with **MATURAU** allowed for an increase and uniformity in berry color, with evident effects about ten days after the treatment (Pictures 7 and 8). There is no effect or alteration of the main chemical-physical parameters of the grape and no effect was found on the water status of the vines. The colorimetric parameters observed on the grapes treated at the first harvest (September 16th) and the derived CIRG index showed a positive effect of the Mugavero treatment on the grapes (Graph 1).

Graph 1. CIRG values for Crimson in 2022. ⊣ = standard deviation.



From the observation of CIRG values on apical, median and basal sections of the berry, a better uniformity in berry coloration has emerged in the treated thesis (Graph 2).

Graph 2. CIRG values for 2022 for the apical, median and basal sections of the berries on Crimson seedless

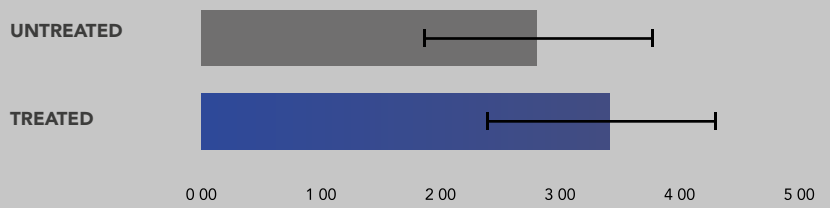


Picture 7 and 8. Application of the color protocol on red table grapes cv Crimson Seedless. Detail of the treated cluster (SX) and untreated (DX).

In the second year 2023, the treatment with **MATURAU** was carried out on September 11th with a single application when more than 60% of the bunches were colored. Four surveys were conducted on September 20th, October 3rd, 11th and 22nd as shown in the following scheme.

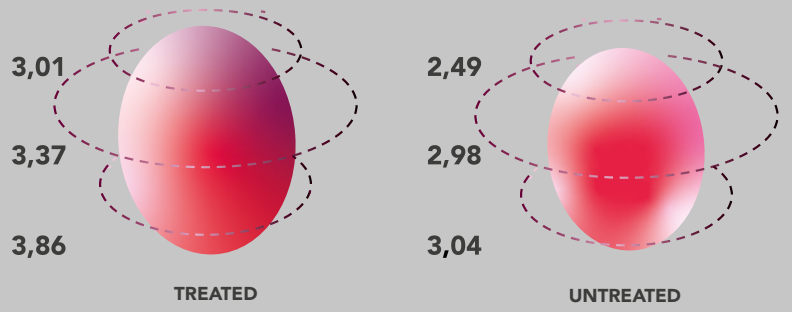
Clusters from different trials (clusters more and less matured) were marked, and the harvesting progress of marked clusters in the field was monitored.
Differences between treated and untreated grapes were determined 22 days after treatment (October 3rd, 2023); Higher values were recorded in the treated trials, specifically a 5.6% increase in average berry weight and a 6.4% increase in total soluble solids/acidity ratio.

Graph 3. CIRG values for Crimson in 2023 ⊣ = standard deviation.



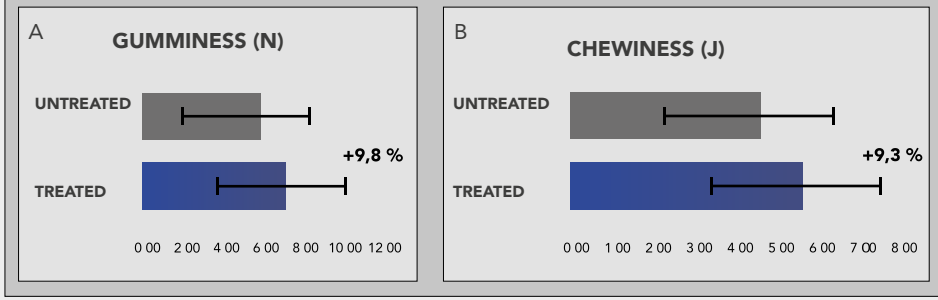
The best coloration values in terms of CIRG index per berry and for its apical, median, and basal sections were recorded, once again, in the Mugavero trial as evidenced by Graphs 3 and 4.

Graph 4. CIRG values for 2023 for the apical median and basal sections of the berries on Crimson seedless.



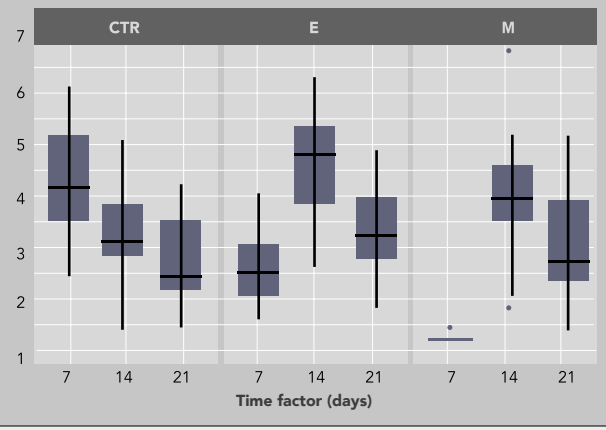
In the analysis of table grape texture at harvest, higher values of gumminess (N) and chewiness (J) were found in the treated trial compared to the control, respectively 9.8% and 9.3%; These values indicate greater skin resistance and better pulp crispness. (Graph 5).

Graph 5 Texture Profile Analysis parameters at harvest. ⊣ = standard deviation.



Texture Analysis was also conducted on grape samples subjected to "ionization" and cold storage: the results showed a greater skin resistance and berry consistency in the treated grapes after 7, 14 and 21 days compared to both the control and the competitor Ethephon as evidenced by Graph 6 below.

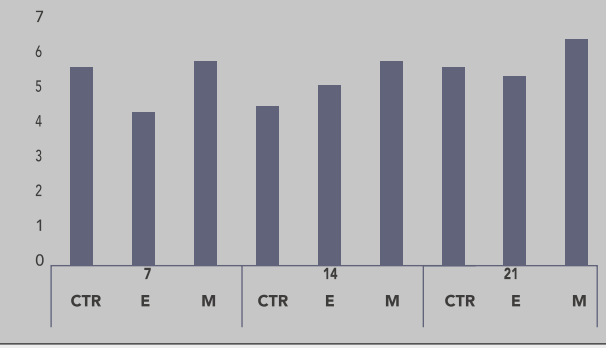
Graph 6. Gumminess (N) values in the berry in cold-stored grapes.



CTR: Control
E: Ethephon
M: Maturau

Cold-stored and **MATURAU**-treated grapes also showed the best organoleptic quality, remaining palatable even after cold storage. This is evident from Graph 7, which shows the trend of the total soluble solids to acidity ratio (TSS/TA) in cold-stored samples for 7, 14 and 21 days.

Graph 7. Total soluble solids to acidity ratio (TSS/TA) in Crimson seedless grapes treated with ionizer and subjected to cold storage for 7, 14 and 21 days



CTR: Control
E: Ethephon
M: Maturau

Study on red table grape cv Allison® seedless and results of the coloring protocol application.[2]

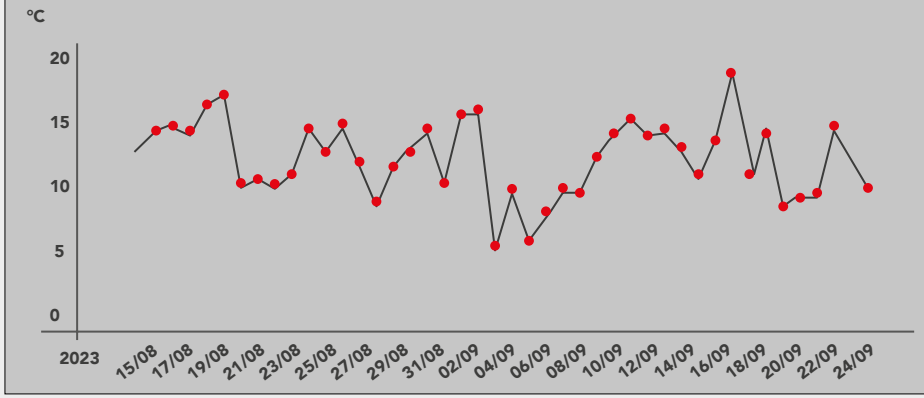
In the Ginosa (TA) area, on a 4-year-old table grape vineyard with a planting spacing of 3 x 3.2 meters of the seedless red grape cultivar Allison® grafted on 1103 P rootstock, the Mugavero protocol was applied starting from the beginning of veraison stage (BBCH 81); This protocol was compared with the "conventional" protocol, which involved 6 foliar applications of magnesium sulfate at a rate of 6 liters per hectare and weekly fertigation with nutrient solutions, providing a total nutrient contribution per hectare of 61 units of nitrogen, 47 units of phosphorus, and 96 units of potassium.

Table 3. Timing of application and quantities of products applied on red grape cv Allison seedless

DATA	21 AUGUST	21 AUGUST	6 SEPTEMBER	12 SEPTEMBER	18 SEPTEMBER
RATES per ha	STATIA 5 L	STATIA 5 L	STATIA 5 L	STATIA 5 L	MATURAU 5 L
			UPPER GROW 2.5 L	UPPER GROW 2.5 L	
RATES per ha	UPPER GROW 5 L	UPPER GROW 5 L		UPPER GROW 5 L	
	NIGER 700 4 Kg	NIGER 700 4 Kg		NIGER 700 4 Kg	

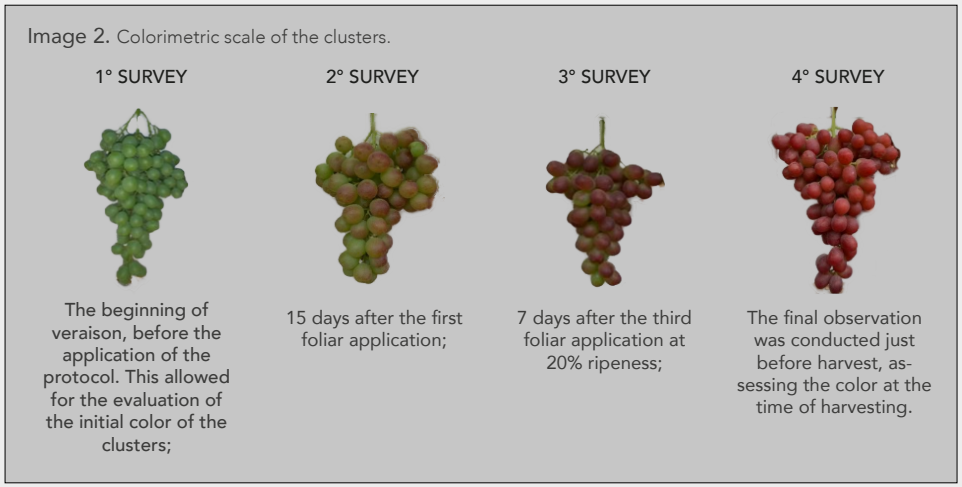
The trial vineyard's climatic parameters, air humidity, and temperature (°C) were monitored. Special attention was given to daily temperature fluctuations during the period from August 15th to September 24th, 2023 (Graph 8).

Graph 8. Daily temperature fluctuations from August 15th to September 25th.



The evolution of veraison was monitored on 18 plants for the thesis and 3 clusters per plant, observing the same clusters until ripeness. To perform this evaluation, a colorimetric scale was used. The observation was repeated at four stages from the beginning of veraison (Image 2).

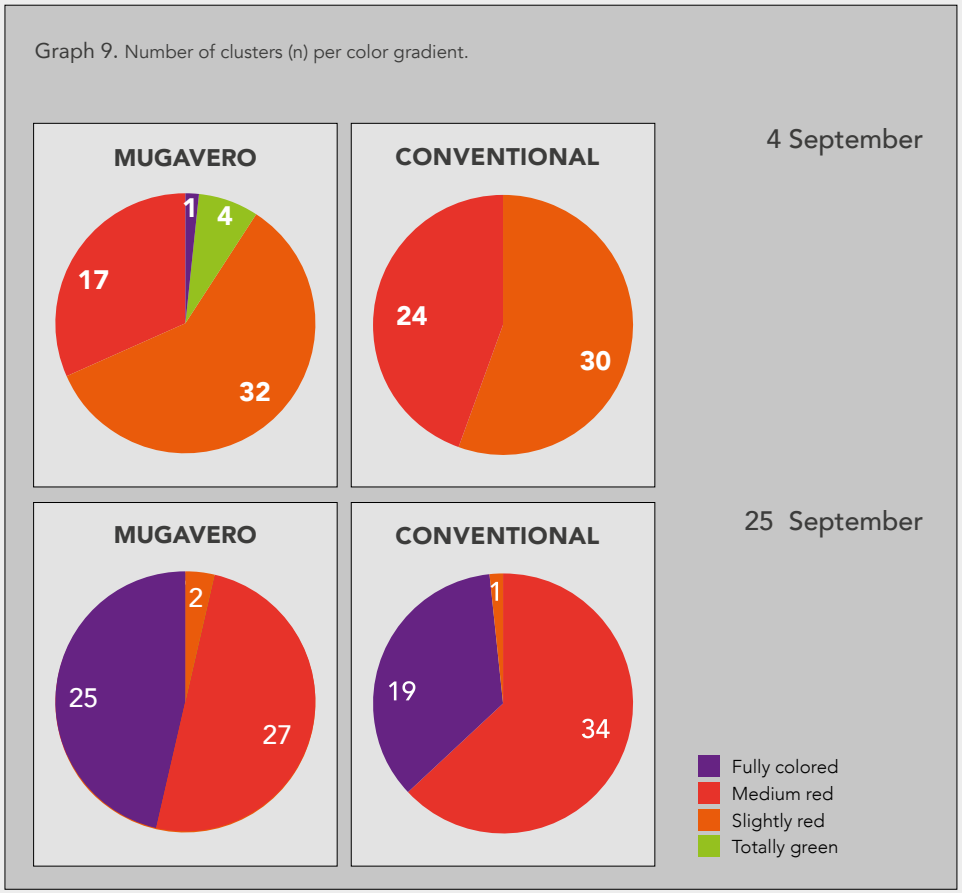
Image 2. Colorimetric scale of the clusters.



The effectiveness of the protocol in inducing coloration and improving the quantitative and qualitative parameters of the production was evaluated.

Following the surveys and observations conducted in the field, the following aspects emerged regarding the color parameter: the Mugavero thesis showed a more extensive achievement of coloration before the company thesis, as evidenced by the pie chart representation (Graph 9).

Graph 9. Number of clusters (n) per color gradient.



The level of coloration increased as expected throughout the trial. Evaluations of color reveal a tendency for both theses to color gradually and evenly. The progression of color was not linear for either thesis; only by September 12th the Mugavero thesis showed a more advanced color level compared to the company thesis.

On September 25th, nearing the first harvest, the Mugavero trial confirmed itself as having a more advanced color level, showing a greater number of level 4 clusters compared to the conventional trial (Picture 9).
It is also noteworthy that, since the harvesting of red varieties is staggered, the lot chosen by the commercial team to begin harvesting was from the Mugavero trial.
Regarding the quantitative parameters of the grapes at harvest, no differences were found between the two trials, which were statistically comparable, despite the data slightly favoring the Mugavero trial.

After 30 days of storage in the cold storage, a consistency loss of 5.5% was observed for the Mugavero trial and 6.6% for the conventional one.

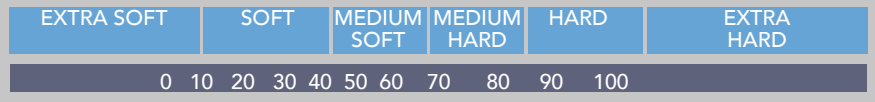
Specifically, according to Shore scale (Graph 10):

MUGAVERO: the average consistency of the berries went from 85.5 to 79.9.

CONVENTIONAL: the average consistency of the berries went from 86.3 to 80.3.

More interestingly, data related to shelf-life evaluation highlighted that, despite a slightly higher weight loss in the Mugavero trial, clusters treated showed better consistency and sanity compared to conventional plants (Graphs 11 and 12).

Graph 10. Shore scale used to calculate the berry consistency.



Picture 9. Overview of the cv Allison vineyard on October 3rd, 2023.

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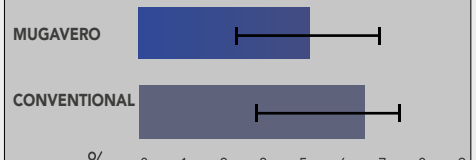
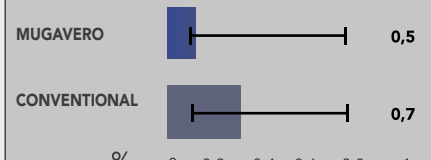
Results and discussions/ Cv Allison seedless

Picture 10. Preparation of clusters for cold storage.

Graph 11. (%) Loss of berry consistency after 30 days of cold storage; ⊣ = standard deviation



Graph 12. (%) Incidence of rotting and mold on grapes after 30 days of cold storage.



A minimal incidence of rotten berries was also observed in both theses (Picture11)

Picture 11.Condition of clusters after 30 days of cold storage, with detail of treated (left) and untreated berries (right).

STATIA

1-5-20 L | Foliar | Zero Residue

STATIA is a resistance inducer based on lignosulfonates with an innovative formulation that is completely soluble and quickly assimilated by plant tissues, containing phosphorus, potassium, and magnesium. Statia can be applied regularly throughout the vegetative and productive cycle of the crop, enhancing vegetative vigor and shifting the sink-source balance towards flowering and fruit production. It helps maintain plant sanity and reduces the usage of fungicides and insecticides used in defense strategies.

STATIA significantly improves tissue lignification, promoting vineyard uniformity, which is essential for fruit ripening. Near veraison, **STATIA** promotes sugar synthesis and acid degradation. It can also be used in combination with fungicides, insecticides, and biostimulants at a suggested dose of 5 liters per hectare.

MATURAU

1-5-20 L | Foliar | Zero Residue

MATURAU is an organic biostimulant containing potassium complexed with organic molecules and natural extracts of jasmonic acid, designed to complete fruit ripening and coloring processes through foliar application.
Maturau primarily acts on fruit coloring by promoting chlorophyll degradation and synthesis and accumulation of anthocyanins. It also helps strengthen the cell walls of plant tissues.
MATURAU should be applied at a rate of 5 liters per hectare when the fruit has reached 60% of its color change on the epicarp, on well-hydrated plants without symptoms of water stress.
Its unique formulation ensures the product is readily assimilated and completely metabolized without leaving residues. The results can be noticeable within 4-6 days after treatment.

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Mugavero Products / Table Grape Protocol

UPPER GROW

1-5-20 L | Foliar | Fertigation

UPPER GROW is a liquid biostimulant rich in potassium and nitrogen with an organic matrix. It is applied foliarly or through fertigation during fruit growth and maturation, enhancing sugar content and improving the texture, color, and shelf-life of the fruits.

In the latter case, it also improves the physico-chemical properties of the soil by increasing nutrient availability in the circulating solution and enhancing the cation exchange capacity (CEC) of the soil system.

Thanks to its high-quality formulation, Upper Grow can be used from the early stages of veraison (BBCH 81) until pre-harvest

NIGER 700

10 Kg | Fertigation

NIGER 700 is a water-soluble NPK fertilizer with a low PH, enriched with humic and fulvic acids, ideal for the final stages of berry enlargement and preparatory for the maturation phase when a rapid synthesis of anthocyanins is required. The product combines organic acidification with a balanced supply of readily available potassium for the plant. NIGER 700 aids the plant during the veraison phase, when the berry begins to color.

The NPK ratio promotes berry development while ensuring the plant has the necessary vigor for the second vegetative growth phase without imbalance.
It is recommended to use the NIGER line in drip irrigation systems and always respecting the fertilizer dilution ratios.

NOTE

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Color protocol
TABLE GRAPE

RESEARCH PARTNERS

*1) Research activity carried out by **Dipartimento di Scienze Agrarie Alimentari e Forestali (SAAF)**, Università degli Studi di Palermo, Rosario Di Lorenzo, Carmelo Talmi , Vittorio Farina, Angelo Buscaglia, Roberta Passafiume, Alessandra Culmone, Antonino Pisciotta*

Technical coordination by: Carlo Gambino - Mugavero fertilizzanti

*(2) Research activity carried out by **Graper Srl** – Via f.lli Coletta, 14 -70014 – Conversano (Ba)*

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