PhD School on Agriculture, Environment and Bioenergy

(http://sites.unimi.it/dottorato_aab/)

(XXXVIII cycle, 2022-25)

Project draft

1.Field of interest

*Indicare **il/i** settore/i scientifico disciplinari:*

2.Project title

INNOVATIVE CHEMICHAL AND PHYSICAL ELICITOR TREATMENTS TO IMPLEMENT ANTIOXIDANT CONTENT AND RESISTANCE TO ADVERSITY IN BLUEBERRY (VACCINIUM CORYMBOSUM L.)

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4.Relevance of the topic and state of the art:

Treatments with elicitors - biotic or abiotic, chemical or physical - aim to increase resistance to adversity, especially pathogens. Although elicitors were initially used to increase plant resistance to pathogens, the mechanism has been found to be involved in the increase of the level of phenols, i.e. flavonoids, because it can trigger distinct changes in the plant's secondary metabolism (Gutiérrez-Gamboa, 2019). Consequently, elicitors can be considered an interesting tool to obtain plants with a higher phenols content with positive consequences on the nutraceutical content of the fruit (Cocetta et al, 2015). Induced resistance also has a positive impact on the environment as the treatments are often sustainable and if carried out in the field do not lead to the presence of toxic residues either on the plants/fruits or in the environment and the induced resistance to pathogens leads to a reduced use of pesticide. Additionally, loss of fruit can be reduced when treatments are applied post-harvest before the storage.

The improvement of the nutraceutical characteristics of the fruit, the reduction in the use of chemicals, sustainability and the low postharvest losses are all positive aspects that promote studies regarding this new type of intervention in fruit and vegetable production. Moreover, the content of flavonoids is affected by genetic differences and also by physiological processes which take place during maturation and ripening of berry fruits (Spinardi et al, 2019; Cocetta et al, 2012). Phenolic metabolism and anthocyanin accumulation is also highly influenced by the environmental conditions. The interaction between major environmental factors such as temperature and solar radiation and the maturation process is important in altering phenols composition in berries.

Blueberries (Vaccinium spp.) are important fruits with a high market value. They are gaining popularity all over the world thanks to their rich nutritional composition, organoleptic characteristics and possible health benefits. In fact, their high content of phenolic compounds with important antioxidant effects are due to the beneficial properties for health widely described. The possibility of further increasing the content in bioactive substances and, at the same time, improving the resistance of plants and fruits to adversities would make it possible to increase their value even further.

5.Layout of the project (draft)

This project aims to improve the organoleptic, nutraceutical and shelf life characteristics of blueberries and the potential for industrial exploitation of the extracts.

The blueberry is a very interesting fruit considering its bioactive components.
However, through chemical or physical treatments, the nutraceutical characteristics can be implemented for the fresh market or for exploitation in the pharmaceutical industry and the resistance to different adversities increased. The use of sustainable treatments leads to a reduction in the use of chemicals with environmental, health and economic advantages. The aims are:
- to increase the anthocyanin profile of fruits in order to improve the qualitative and nutraceutical characteristics for consumers.
– to improve and uniform the colour of fruits at ripeness.
– to reduce mould and pathogens to extend shelf life and reduce waste.
– to evaluate the gene expression of phenylpropanoid biosynthetic pathway in response to different treatments (pre- and postharvest) and environmental conditions in different cultivars
– to link differences in anthocyanin content and profile with environmental conditions during the maturation period

5.1. Materials & Methods:

WP1: chemical analysis of berries after pre- and postharvest treatments: anthocyanin and phenolic contents, anthocyanin and phenolic profiles, antioxidant capacity.

WP2: evaluation of environmental factors during berries maturation and their effects on bioactive compound contents and profiles

WP3: Analysis of expression patterns of genes involved in synthesis of bioactive compounds, in response to pre- and postharvest treatments

5.2. Schedule and major steps (3 years):

Activities	First year	Second year	Third year
	WP1	WP1	
	WP2	WP2	
		WP3	WP3

6. Available funds: 15,000 € by RV_MIUR16ASPIN_M

6. Literature:

Gutiérrez-Gamboa, G., Romanazzi, G., Garde-Cerdán, T., & Pérez-Álvarez, E. P. (2019). A review of the use of biostimulants in the vineyard for improved grape and wine quality: Effects on prevention of grapevine diseases. Journal of the Science of Food and Agriculture, 99(3), 1001-1009.
Cocetta, G., Rossoni, M., Gardana, C., Mignani, I., Ferrante, A., Spinardi, A. (2015). Methyl jasmonate affects phenolic metabolism and gene expression in blueberry (Vaccinium corymbosum). Physiologia Plantarum 153: 269-283, doi: 10.1111/ppl.12243, doi: 10.1002/jsfa.9353.
Spinardi, A., Cola, G., Gardana, C. S., Mignani, I. (2019). Variation of anthocyanins content and profile throughout fruit development and ripening of highbush blueberry cultivars grown at two different altitudes. Frontiers in Plant Science, 10: 1045, doi: 10.3389/fpls.2019.01045.
Cocetta, G., Karppinen, K., Suokas, M., Hohtola, A., Häggman, H., Spinardi, A., Mignani, I., Jaakola, L. (2012). Ascorbic acid metabolism during bilberry (Vaccinium myrtillus L.) fruit development. Journal of Plant Physiology 169: 1059-1065, doi: 10.1016/j.jplph.2012.03.010.