International Scholars Journals

International Journal of Enology and Viticulture ISSN 2756-3685 Vol. 8 (2), pp. 001-003, November, 2021. Available online at www.internationalscholarsjournals.com © International Scholars Journals

Review Article

Precision viticulture and wildfire emergencies: Effects of smoke on the vine and localization of damage

Brunori1 E, Biasi R, Maesano M, Moresi FV, Bellincontro A, Mencarelli F*

Department of Innovation in Biological, Agro-Food and Forestry Systems (DIBAF) University of Tuscia, via San Camillo De Lellis snc, Viterbo, Italy.

Accepted 03 November,2021

Abstract

Lightning-ignited fires, one of the major bushfire causes are increasing also in Europe and in Italy reached the maximum annual flash density of Europe took places in hill and rural areas and caused direct damage burning thousands of hectares of native vegetation but also indirect cost on Mediterranean agro-ecosystems, as with smoke-exposure grape, that exhibits ashy characters resulting in wines described as smoke tainted and cause significant direct economic losses. Research activity clarified the uptake and the translocation of smoke taint to the fruit and wine, other focus on treatments in field and winery, but only little research focus on damage quantification and localization. Precision Viticulture (PV) carried out through Unmanned Aerial Vehicle (UAV) based visible images can act for in-field detection of smoke contamination and for quantifying damage at vines level. It is crucial tools to increase wine grower resilience to climate-related disaster risk (bushfire) and to ensure a financial compensation through insurance based on the estimation of threshold of damages.

Keywords: Precision Viticulture, Unmanned Aerial Vehicle, bushfire

INTRODUCTION

Wine sectors is experimenting an unprecedented climate crisis that is not uniform globally but happening in a complex and spatially heterogeneous pattern of rainfalls, extreme events and warming [1]. Climate changes is also linked to increased lightning activity associated with wildfire (lightning-ignited fires) that occur in large spatial and temporal clusters and usually in remote locations and burn larger areas than human-caused ignitions.

Lightning-ignited fires, one of the major bushfire causes, have devastated California, Australia, and unfortunately these phenomena are increasing also in Europe and especially in the northeast of Italy, where the annual flash density reached the maximum of Europe in the last ten years and as unfortunately evidenced the wildfires raging throughout Sardinia and Sicily and where tens of thousands of acres have gone up in flames. In the Annual Report on Forest Fires in Europe 2019 season has been elected as 'the worst-ever year for forest fires around the world in recent history'. In fact, more than 60,600 fires have occurred in Italy and over 400,000 hectares of Europe's natural land was burnt and a record high number of nature protection areas were affected by the Wildfires. By March 2019, before the 'fire season' in most EU's countries, the total burnt area was plenty above the annual average of the last 12 years. In addition, most of them took places in hill and rural areas sensitive and vulnerable areas also for other land degradation drivers such as complex orographic condition, land abandonment, landslides.

LITERATURE REVIEW

Wildfire have short term impact burning millions of hectares of forest, agricultural and pastoral systems, killing people and destroying property and community disturbance, but have also long-term impact on native fauna and species, on health effects of human also in nearby areas caused by fire smoke [2].

Smoke derived by forest fire contents 90% of CO_2 and water vapor, while the 10% contains dangerous compounds such as Carbon Monoxide (CO), Volatile Organic Compounds (VOCs) derived from celluloses and hemicelluloses decomposition such as a broad range of alkanes and alkenes, isoprene and monoterpenes hydrocarbons, aldehydes, alcohols, , benzene and

*Corresponding author. Yu Dong, E-mail: dongy@oregonstate.edu.

alkyl benzenes, and Polycyclic Aromatic Hydrocarbons (PAHs) and methoxylated phenols such as guaiacol and syringol from lignin decomposition, and finally Particulate Matter (PMs) known as probable carcinogens/toxics molecules.

In particular, guaiacol (2-methoxyphenol), 4-methylguaiacol and syringol (2,6-dimethoxyphenol) are the most abundant volatile phenols in smoke, and are likely involved in the perception of smoky flavours in food due to low sensory threshold.

Recent scientific research focus on long-term effects of smoke exposure on grape quality that exhibits ashy characters resulting in wines described as smoke tainted and cause significant direct economic losses - damage to vineyards and wineries, but above all the biggest economic damage is the result of persistence smoke taint of wine. In addition, it has been investigated also the impact on Vitis vinifera L. and their physiological response to smoke exposure. In particular, advancing in this understanding has become even more critical and urgent in lots of winegrowing areas around the world.

A quantitative literature paper has been carried out on Scopus advanced search databases using as keywords: 'bushfire AND smoke AND Vitis vinifera L.'. The analyse search results tools allowed us to obtain in the temporal range of 30 years the exponential trend of number of research paper concerned bushfires and their long and short -term impact on grapevine and to highlighted that about the 60% of them cloud be grouped in chemistry and agricultural and biological sciences subject areas. Using the words of abstract of all published works on these topics and a Voyant Tools a web-based reading and analysis environment for digital texts reporting word occurrence related to contest/sentence, it has been generated a tag cloud a novelty visual representation of text data, that allowed us to depict keywords the first 100 words according to their occurrence and their relationship in the sentences. Keywords the more frequent words in all abstracts (smoke (168); grapes (57); wines (54); volatile (45); phenols (44)) are showed in blue colour and words nearby them related to contest/sentence in orange [3]. To do it, firstly, we extracted words and excluded prepositions, corrected spelling mistakes, removed plurals, punctuation (e.g., capitalization), and automatically combined words that are almost identical, finally we performed simulator visualize only.

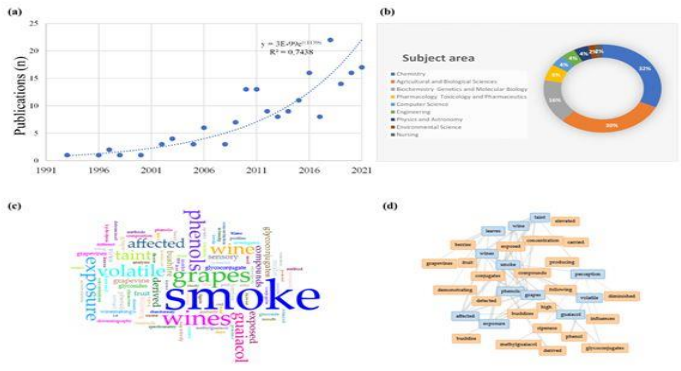

Figure 1. The exponential increased in scientific paper (a) and their subject area (b) concerned 'bushfire AND smoke AND Vitis vinifera L.' on Scopus advanced search databases. Text analysis performed by Voyant Tools showed the most occurrence words and their relationship in the selected abstract words of all scientific paper in the temporal range 1991-2021.

Findings showed as most of the published research aimed to analyse the effect of smoke exposure of grapes and vines on berry composition, wine composition and sensory properties caused the guaiacol and syringol derivatives and other phenols in the smoke.

Research activity clarified the uptake and transformation process helping to define how smoke-derived volatile phenols are directly absorbed via berry's cuticle and via leaves, how they are translocated to the fruit and glycosylated. It has been studying the effects on cultivars, phenological phase and intensity of smoke exposure on the accumulation of volatile phenol glycoconjugates in smoke-exposed grapes, and wine.

In the last decades, research focused also on select biomarkers for identifying smoke exposure of grapes, on viticulture practices, innovative treatments and Oenological approaches to ameliorate smoke taint in berry and/or in wine.

Among the last research it has been introduced the precision viticulture technologies using Unmanned Aerial Vehicle (UAV) based visible images or in-field detection system for smoke contamination in vine canopies using Near-Infrared Spectroscopy (NIR) as inputs for machine learning fitting modelling. Although the growing interest around these topics, few research focused on in-field damage detection caused by smoke exposure of vine and grape and in addition on its geo-localization [4]. It is crucial steps to adopt tempestive and targeted treatments in vineyards, to reduce timing, costing and to reduce the effects of smoke on grape quality.

In the Era of climate changes, where it will predictable an increase in frequency and destructive force of extreme weather events around the globe, agro-ecosystems are being continuously disturbed. Such conditions impose and exacerbate abiotic and biotic stressors and farmers will deal with the consequences. EU has started to integrate adaptation into several of its own policies and financial programmes, promoting in the EU Adaptation Strategy actions that should contribute to a more climate-resilient agriculture. Among this strategies insurance could be a tool against extreme weather events in climate risk management ensuring a financial compensation for losses after an extreme weather event, insurance can provide incentives also to reduce risk [5]. According to methodology proposed, the damage can be identified with a spatial high resolution (2 centimetres) and above all can be quantified using the Canopy Area Health Index (CAHI) index. It takes into consideration the area of living leaves and dead ones related to canopy's total area obtained by high resolution RGB images CAHI is a dimensionless index ranges between +1 and−1 (+1: 100% healthy canopy with green foliage; −1: 100% damaged canopy with dead foliage). It also could be integrate with a machine learning model to map contaminated areas of vineyards, including berry quality traits affected by smoke. Finally, it is a versatile index also for damage assessment induced by other extreme climate events, such as multiple summer stressors.

CONCLUSION

In view of increase in frequency and destructive force of extreme weather events around the globe and of request of a faster transition towards ecological intensification in agriculture advancing in understanding the impact on climate extreme events on viticulture systems has become even more critical and urgent. Drivers, processes, and management of catastrophic shifts must be study using precision viticulture technologies promising solution that integrate low cost, high-resolution cameras, and autonomous capabilities able to highlight ways forward for the site-specific management of Mediterranean ecosystems and also to ensure new adaptation strategies to climate changes, such as damage estimation and the recourse to insurance as EU promoted strategies to climate adaptation.

Using vegetational indices such as CAHI, farmers can apply site specific management and on the other hands can estimated damages produced from shocks due to unexpected weather events and can benefit significantly from the use of insurance instrument that would seamlessly not only cover damage but also incentive risk reduction behaviours. Crop insurance requires farmers must choose from different thresholds that would trigger the indemnification, with the premium price varying according to the trigger level chosen. For this region is important to estimate damage, to certify it and to help especially smallholder to obtain financial efforts to compensate for losses.

ACKNOWLEDGMENTS

The research has been partially supported by project funds, WineSens (Regione Toscana.

Por Fesr Toscana 2014-202, Azione 1.1.5 Sub.A1) Bando N. 2: Progetti di ricerca e sviluppo delle MPMI) and VIOLoC (FISR-MIUR).

REFERENCES

1. Brunori E, Maesano M, Moresi FV, Matteucci G, Biasi R, Scarascia Mugnozza G (2020) The hidden land conservation benefits of olive-based (Olea europaea L.) landscapes: An agroforestry investigation in the southern Mediterranean (Calabria region, Italy). Land Degrad Dev. 31: 801-815.
2. Brunori E, Maesano M, Moresi FV, Antolini A, Bellincontro A, Forniti R, et al. (2020) Using UAV-based remote sensing to assess grapevine canopy damage due to fire smoke. J Sci Food Agric. 100: 4531-4539.
3. Enno SE, Sugier J, Alber R, Seltzer M (2020) Lightning flash density in Europe based on 10 years of ATDnet data. Atmos Res. 235: 104769.
4. Krstic MP, Johnson DL, Herderich MJ (2015) Review of smoke taint in wine: smoke-derived volatile phenols and their glycosidic metabolites in grapes and vines as biomarkers for smoke exposure and their role in the sensory perception of smoke taint. Aust J Grape Wine Res. 21: 537-553.
5. Modesti M, Szeto C, Ristic R, Jiang W, Culbert J, Bindon K, et al. (2021) Potential Mitigation of Smoke Taint in Wines by Post-Harvest Ozone Treatment of Grapes. Molecules. 26: 1798.