Journal of Agricultural Sciences Research

ISSN 2764-0973 vol. 5, n. 7, 2025

ARTICLE 9

Data de Aceite: 22/12/2025

EVALUATION OF BIOHERBICIDES FOR THE CONTROL OF FIELD BINDWEED (CONVOLVULUS ARVENSIS L.) IN VINEYARDS OF THE COAST OF ENSENADA BAJA CALIFORNIA, MEXICO

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ABSTRACT: Mexico's main wine-producing region is located on the coast of Ensenada, Baja California, where favorable climatic conditions enable the production of 70% of Mexico's highest-quality wines. The perennial weed field bindweed (*Convolvulus arvensis* L.) poses a significant threat for regional grape growers, due to its difficult control and its impact on production costs. One of the main strategies used to control field bindweed is the herbicide glyphosate, a broad-spectrum systemic agrochemical with harmful effects on human health and the environment. The objective of this study was to evaluate bioherbicides to determine as an alternative to glyphosate for controlling field bindweed in vineyards. Three commercial bioherbicides made from extracts of annual plants, pine resins, and the fungus *Puccinia* were tested, along with glyphosate as a control. The results showed that after 29 days of evaluation, only the HO3 bioherbicide was able to match glyphosate, achieving 83% control compared to glyphosate's 87%. It was also observed that the three bioherbicides had similar effects on the fresh and dry weight of bindweed rhizomes as those achieved with glyphosate.

KEYWORD: glyphosate, bioherbicides, Binweed, wine grape

INTRODUCTION

Mexico's main wine-producing region is located on the coast of Ensenada, Baja California (B.C.), where 70% of the country´s highest-quality, are produced. Approximately 4,611 hectares are cultivated in this region, yielding 27,752 tons of fruit (SIAP 2024). The perennial weed field bindweed (*Convolvulus arvensis* L.) is one of the most widespread and important weeds globally (Nasser et al., 2024), and poses a significant challenge for regional winegrowers due to the difficulty of controlling it and its impact on vineyard production costs.

Glyphosate, a broad-spectrum systemic herbicide, is one of the main strategies used to control bindweed, however, it has been attributed with harmful effects on human health and the environment (Bai and Ogbourne 2016; Meftaul et al., 2020; García-Villanueva et al., 2024;). Less risky methods are available, such as mechanical tillage, though this must be carried out frequently, every two or three weeks, when the weed reaches approximately 15 cm in length (Hodges 2003). In turn, Reynolds et al. (2025) indicate that the use of a manual gasoline-powered rotary cultivator or brush cutter could represent more sustainable weed control alternative to glyphosate. Biological control strategies have also been explored. For instance, Boydston and Williams (2004) and Rodriguez-Navarro et al. (2011), investigated the use of the root-knot mite (*Aceria malherbae* Nuzzaci) for bindweed control. Other studies have shown that bioherbicides derived from plant extracts can also aid in controlling this weed (Pouresmaeil et al., 2020). Bioherbicides offer several advantages over synthetic herbicides, including selectivity, minimal effects on non-target organisms, absent of harmful residues, and a low incidence of resistance (Pacanoski, 2015). The objective of this work was to evaluate three bioherbicides as potential alternatives to glyphosate for controlling field bindweed in the vineyards of the Guadalupe Valley, B.C., Mexico.

MATERIALS AND METHODS

The study was conducted from June 1 to August 8, 2022, in a drip-irrigated vineyard located in the Valle de Guadalupe, Baja California, which was naturally infested with bindweed (Figure 1). On June 20, the following herbicides treatments were applied: 1) HO1 at 1.5%; 2) HO2 at 1.5%; 3) HO3 at 2.0%; 4) Glyphosate at 1.0%; and 5) an untreated control. A randomized complete block design with four replicates was used. According to the manufacturers, HO1 contains 40% conifer oil, 42% plant extracts, and 10% of *Datura stramonium* L. extract; HO2 is formulated with 20% mullein (*Gnaphalium viscosum* Kunth), 20% coconut oil, 20% pine resin, 20% *Puccinia* fungus, and additional ingredients; and HO3 is composed of 38% wild plant extracts, 20% pine resin, 15% *Puccinia*, 10% organic acids, and other components.

The percentage of bindweed control achieved by the treatments was visually estimated within a 60 x 60 cm metal frame at 7, 14, 22, and 29 days after the application. At the end of the study, rhizomes samples were collected from each replicate and treatment within a 60 x 60 cm area to a depth of 20 cm (Figure 2). The rhizomes were weighed fresh and then dried at 70°C for 48 hours in a forced-air oven to obtain dry weight. Data from the visual assessments and the rhizome were analyzed statistically, and Tukey's tests at the 5% significance level were applied when significant differences were detected in the analysis of variance.

Figure 1. Experimental vineyard infested with bindweed

Figure 2. Bindweed rhizome sampling sites

RESULTS AND DISCUSSION

Effects on the aerial parts of bindweed

Statistically significant differences in bindweed control were observed among treatments across all four sampling dates (Table 1). On the first sampling date, seven days after the application of the bioherbicides, control percentages were generally low. The highest levels of suppression were recorded for bioherbicides HO1 and HO2, with 7.5% and 19% control, respectively. Glyphosate, meanwhile, achieved only 2.5% control, similar to the untreated control and HO3. This result aligns with findings from other authors, who have reported that glyphosate provides limited control of bindweed within the first week after application, with effectiveness increasing over time (Karaman and Tursun, 2024).

At the second sampling date, bioherbicides HO1 and HO2 showed the highest control percentages, although the values remained low, at 12.5 and 21.25, respectively. By the third sampling date, herbicide HO3 exhibited the highest control at 63%, slightly outperforming glyphosate, which reached 55%.

At the fourth and final sampling date, 29 days after treatment application, glyphosate and HO3 produced the highest control percentages, at 87% and 83%, respectively (Figures 3 and 4). According to the European Weed Research Council, these values fall within the range of good efficacy (Püntener and Zahner, 1981).

Other studies have similarly reported that bioherbicides made from plant extracts can suppress bindweed (Pouresmaeil et al., 2020), Bermuda grass (*Cynodon dactylon* L.) (Valenzuela and Tamayo, 2024), and various other weeds (Rys et al., 2022), suggesting that this products may offer a less toxic and more friendly alternative to conventional herbicides.

	Binweed control (%)			
Treatment	**7DAA**	**14DAA**	**22DAS**	**29DAA**
HO1	7.50 a*	12.50 a	45.00 ab	45.00 b
HO2	18.75 a	21.25 a	21.25 b	35.00 b
HO3	1.25 b	4.50 b	62.50 a	82.50 a
Glyphosate	2.50 ab	7.50 b	55.00 ab	86.50 a
Control	0.00 b	6.25 b	20.00 b	12.50 c

Table 1. Effect of the treatments applied on the control of bindweed in a vineyard in the Guadalupe Valley, B.C. DAA=Days After Application.

*Means with the same letter are not significantly different at $p < 0.05$, Tukey test.

Figure 3. Bindweed control with glyphosate

Figure 4. Bindweed control with the bioherbicide HO3

Effects on Bindweed Rhizomes

The effects of the treatments on the fresh and dry weights of bindweed rhizomes collected 29 days after application are shown in Figure 4. The greatest reduction in fresh rhizome weight was achieved with the bioherbicide HO3; however its effect was statistically similar to that of the other bioherbicides and to glyphosate, while all treatments performed better than the untreated control. A similar trend was observed for dry weight. Specifically, the bioherbicide HO3 significantly reduced dry weight rhizome compared to the control, but this reduction did not differ statistically from that produced by the other two bioherbicides or glyphosate. These results indicate that the three bioherbicides evaluated had effects comparable to those of glyphosate on both fresh and dry bindweed rhizome weight, suggesting that any of them may serve as a viable alternative to glyphosate.

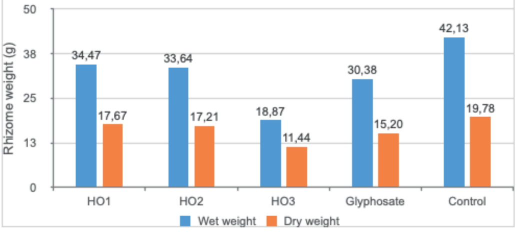

Figure 5. Fresh and dry weights of bindweed rhizomes 29 days after the application of bioherbicides and glyphosate.

CONCLUSIONS

1. The bioherbicides produced levels of foliar bindweed control comparable to glyphosate during the first three sampling dates. By the final sampling date, only the bioherbicide HO3 matched glyphosate, achieving 83% control compared to 87% with glyphosate.

2. The bioherbicides had similar effects on the fresh and dry weight of bindweed rhizomes to those obtained with glyphosate.

REFERENCES

Bai, S.H. and Ogbourne, S.M. 2016. Glyphosate: environmental contamination, toxicity and potential risks to human health via food contamination. Environ Sci Pollut Res 23, 18988–19001.

Boydston, R.A. and Williams, M.M. 2004. Combined Effects of *Aceria malherbae* and Herbicides on Field Bindweed (*Convolvulus arvensis*) Growth. Weed Science, 52(2), 297–301. http://www.jstor.org/stable/4046920

García-Villanueva, L.A., V.H. Cuapio-Ortega, I.Y., Hernández–Paniagua, G. Fernández-Villagomez, J. Rodrigo-Ilarri, M.E. Rodrigo-Clavero, G.L., Andraca-Ayala, G.B. Hernández-Cruz and Banda-Santamaría, S. 2024. Effects of glyphosate on the environment and human health. Nature Environment and Pollution Technology, 23:17-32.

Hodges, L. 2003. Bindweed Identification and Control Options for Organic Production. Historical Materials from University of Nebraska-Lincoln Extension. Publication 48. https://digitalcommons.unl.edu/extensionhist/48

Karaman, Y. and Tursun, N. 2024. Efficacy of glyphosate and 2,4-D on Field Bindweed (*Convolvulus arvensis* L.) under high carbon dioxide and elevated temperature conditions. Pakistan Journal of Agricultural Sciences. 61:451-461.

Meftaul I.M., Venkateswarlu K., Dharmarajan R., Annamalai P., Asaduzzaman M., Parven A. and Megharaj M.2020. Controversies over human health and ecological impacts of glyphosate: Is it to be banned in modern agriculture?. Environmental Pollution, 263 (Pt A):114372.

Naseer, S., Khan, S., Sharif, A and Rahman, K.U. 2024. Allelopathic Effect of Bindweed (Convolvulus arvensis L.) on the Germination and Growth of Zea mays L. The Sciencetech 5: 44-62

Pouresmaeil, M, Nojadeh, M.S., Movafeghi, A. and Maggi, F. 2020. Exploring the biocontrol efficacy of Artemisia fragrans essential oil on the perennial weed Convolvulus arvensis: inhibitory effects on the photosynthetic machinery and induction of oxidative stress. Ind Crops Prod. 155:112785.

Pacanoski Z. 2015. Bioherbicides. Herbicides, Physiology of Action, and Safety. InTech. Available at: http://dx.doi.org/10.5772/61528.

Püntener, W. and Zahner, O. 1981. Manual for Field Trials in Plant Protection.Ciba-Geigy Limited, Basle, Switzerland 205 pp.

Reynolds, C. M.A., Zetina, L. R., Capetillo, B.A., Uribe, G.M. and López, L.J.A. 2025. Mechanical alternatives to eliminate the use of glyphosate in weed control in México's sembrando vida program. Journal of Agricultural Sciences Research 5: 1-15.

Rodríguez-Navarro, S., Rodríguez, M. H., A. Alemán, M. J., Flores-Macías, A. and Torres-Martínez, J.G. 2011. Valuation of quality parameters for rearing *Aceria malherbae* Nuzzaci (Acari: Eriophyidae), a biological control agent of field bindweed, Convolvulus arvensis L., International Journal of Acarology, 37:235-243. http://dx.doi.org/10.1080/01647954.2010.514287 PLEAS

Rys, M., Miastkowska, M, Sikora, E., Łętocha, A., Krajewska, A. and Synowiec, A. 2022. Bio-Herbicidal Potential of Nanoemulsions with Peppermint Oil on Barnyard Grass and Maize. Molecules 27, 3480. https://doi.org/10.3390/molecules27113480

SIAP 2024. Avances de siembras y cosechas. https://nube.agricultura.gob.mx/avance_agricola/ (consultado el 8 de septiembre de 2025).

Valenzuela-Solano, C. and Tamayo-Esquer, L.M. 2024. Evaluation of herbicides for weed control in vineyards of Ensenada, Baja California. J. Agricultural Science Research 4: . DOI https://doi.org/10.22533/at.ed.973414241119