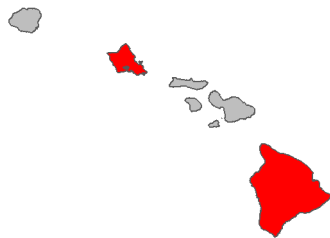


Fire risk report for *Tagetes minuta*

Full Species Name <i>Tagetes minuta</i> L.
Family: Asteraceae
Common names: stinkweed 'okole'oi'oi
Synonyms:
Known occurrences (as of 2020) 
Year first documented as naturalized in Hawai'i: 1932
This species has been ranked by the Hawai'i Weed Risk Assessment program as High Risk with a score of 20.
View photos on Starr Environmental
View on Wikipedia
View occurrences on iNaturalist
View at Plants of Hawaii
View photos on Flickr

0 **I** .5 1
 Lowest risk ⇔ Highest risk

This species is likely a **high** fire risk in Hawai'i with a fire risk score of **0.50**.

This species was ranked by our machine learning algorithm using the data presented on the next page. A predicted score of > .34 suggests the plant is a high fire risk.

Summary of Fire ecology	
Native habitat fire proneness	Fire-prone
Fire promoting plant in its native range	No
Fire promoting plant in its introduced range*	Yes
Regenerates after fire	Yes
Promoted by fire	Yes
Reported flammable*	High
Relative is flammable*	No

*These values were used by the model to predict fire risk

Detailed summary of Fire Ecology

Native habitat fire proneness (In any part of the plant's native range is its habitat described as fire prone due to natural or human caused fires?)	Fire-prone	"[species listed in fire prone area]" https://revistas.ufrj.br/index.php/oa/article/download/8407/6921 Karlin, M., Arnulphi, S., Alday, A., Bernasconi, J., & Accietto, R. (2016). Post-fire revegetation in Acacia spp. shrublands in Sierras of Córdoba, Central Argentina. <i>Oecologia Australis</i> , 20(4).
Fire promoting plant in its native range (Does the species act as a major fuel source, increase fire severity, frequency, or modify fuel bed characteristics within its native range?)	No	
Fire promoting plant in its introduced range (Same as Fire Promoting Native but within the species introduced range)	Yes	"Certain plant types such as <i>Tagetes minuta</i> (Tall khakiweed) and <i>Cosmos bipinnatus</i> (Cosmos) have been reported to be implicated as highrisk plants with regard to fire flashovers. These plants occur where the soil has been disturbed as a result of agricultural or other activities and require special attention during fire prevention planning." https://www.eskom.co.za/OurCompany/SustainableDevelopment/EnvironmentalImpactAssessments/Documents/VegManagGuide.pdf Vosloo, H., SHUNMAGUM, E., & BRUCE, G. : TRANSMISSION VEGETATION MANAGEMENT GUIDELINE Vegetation Management. Eskom Power Series, 2.
Regenerates after fire (Does the plant regrow after fire by any means? This includes resprouters, reseeder, and recruiters which dispersed into the area within approximately one year post fire)	Yes	" Toward the end of its growing season, the aerial parts of <i>T. minuta</i> dry up and may easily be destroyed by fire, but new colonies are formed rapidly in the following season from seeds deposited in the soil" http://41.89.101.166:8080/xmlui/bitstream/handle/123456789/9605/Tagetes%20%28tagetes%20minuta%29%20oils.pdf?sequence=1&isAllowed=y Cornelius, W. W., & Wycliffe, W. (2016). <i>Tagetes</i> (<i>Tagetes minuta</i>) oils. In <i>essential oils in food preservation, flavor and safety</i> (pp. 791-802). Academic Press. -----

		"[seed germination rate declined marginally from ~90% to 80% after a treatment of 110 degrees c.; figure 1a]" https://doi.org/10.1111/aec.12593 Arcamone, J. R., & Jaureguiberry, P. (2018). Germination response of common annual and perennial forbs to heat shock and smoke treatments in the Chaco Serrano, central Argentina. <i>Austral ecology</i>, 43(5), 567-577. ----- "Additionally, we detected species that had higher plant cover with more frequent fires, namely <i>Tagetes minuta</i> that dominated plots in areas with over eight fire years. " https://ntnuopen.ntnu.no/ntnu-xmlui/bitstream/handle/11250/2593517/MBI_2018_Bukombe_etal.pdf?sequence=2 Bukombe, J., Smith, S., Kija, H., Loishooki, A., Sumay, G., Mwita, M., ... & Kihwele, E. (2018). Fire regulates the abundance of alien plant species around roads and settlements in the Serengeti National Park. ----- "The common herbaceous species included <i>Achyranthes aspera</i>, <i>Ageratum conyzoides</i>, <i>Carduus leptacanthus</i>, <i>Laggera crispata</i>, <i>Solanum incanum</i>, <i>Tagetes minuta</i>, and <i>Urtica</i> sp. The regrowth forest on the burned site attained a height of 3–3.5 m within 18 months" https://doi.org/10.1659/0276-4741(2004)024[0354:TIOFOT]2.0.CO;2 Tesfaye, G., Teketay, D., Assefa, Y., & Fetene, M. (2004). The impact of fire on the soil seed bank and regeneration of Haremma forest, Southeastern Ethiopia. <i>Mountain Research and development</i>, 24(4), 354-361.
Promoted by fire (Does the plant increase in abundance after a fire?)	Yes	"Although the abundance of the majority of alien plant species was negatively related to fire, some species, notably <i>Tagetes minuta</i>, had higher cover with more frequent fires." https://ntnuopen.ntnu.no/ntnu-xmlui/bitstream/handle/11250/2593517/MBI_2018_Bukombe_etal.pdf?sequence=2 Bukombe, J., Smith, S., Kija, H., Loishooki, A., Sumay, G., Mwita, M., ... & Kihwele, E. (2018). Fire regulates the abundance of alien plant species around roads and settlements in the Serengeti National Park. ----- "[Density (plants/m²) of <i>T. minuta</i> in unburnt plots: 2 plants, Quadrennial burning 9 plants, Triennial burning 15

		plants, Biennial burning 60 plants, Annual burning 125 plants. Table 2]" #very strongly promoted by fire https://link.springer.com/content/pdf/10.1007/s10530-010-9921-6.pdf Masocha, M., Skidmore, A. K., Poshiwa, X., & Prins, H. H. (2011). Frequent burning promotes invasions of alien plants into a mesic African savanna. <i>Biological Invasions</i>, 13(7), 1641-1648.
Reported flammable (Is the species described as being flammable, being a major wildfire fuel, or high fire risk?)	High	"Certain plant types such as <i>Tagetes minuta</i> (Tall khakiweed) and <i>Cosmos bipinnatus</i> (Cosmos) have been reported to be implicated as highrisk plants with regard to fire flashovers. These plants occur where the soil has been disturbed as a result of agricultural or other activities and require special attention during fire prevention planning." https://www.eskom.co.za/OurCompany/SustainableDevelopment/EnvironmentalImpactAssessments/Documents/VegManagGuide.pdf Vosloo, H., SHUNMAGUM, E., & BRUCE, G. : TRANSMISSION VEGETATION MANAGEMENT GUIDELINE Vegetation Management. Eskom Power Series, 2.
Relative is flammable (Does a plant in the same genus meet the Reported Flammable criteria?)	No	

Text in quotes are direct quotes from the source

Text in square brackets was added by the assessor to clarify something or to summarize from a figure.

Text preceded by a “#” is comment from the assessor

The data presented were assembled from literature and database searches for each species using as much data as could be collected regarding the plant’s fire ecology under natural conditions. Searches aimed to be exhaustive and consist of as much data as could be located in 2020. Our machine learning algorithm was trained on 49 species of plants which had their fire risk ranked by 49 managers in Hawai’i in November 2020. The model used a conditional random forest regression algorithm to predict scores for each species using the manager score as the response variable and the fire ecology traits of each plant as the predictor variables to generate a fire risk score. This trained model was then used to predict the fire risk for all species which were not ranked by managers. The model was calibrated such that it is 90% accurate at

predicting high fire risk plants and 79% accurate at predicting low fire risk plants. This research and the resulting fire risk model has been published in the journal [Biological Invasions](#) by [Kevin Faccenda](#) and [Curt Daehler](#) (both at the University of Hawai'i at Mānoa).

Note that the analysis doesn't account for a plant species' spatial distribution, population density, or distinct climate and ecosystem conditions (which can also influence fire risk). The fire risk of these species are mostly under "worst case" environmental conditions where the climate is dry enough to maintain fire, but wet enough to allow for plant growth and fuel accumulation. The fire risk ranking should not be taken as a stand-alone risk metric in prioritizing weed control efforts. Rather, this information may also be useful for determining if a newly discovered species poses a potential fire threat in wildland areas.

More general information on the weed risks and ecology of non-native plants in Hawai'i is available from the Hawai'i Invasive Species Committee's [Weed Risk Assessment database](#).

View more fact sheets at <https://www.pacificfireexchange.org/weed-fire-risk-assessments>

Fact sheet prepared by Kevin Faccenda (faccenda@hawaii.edu) in November 2021. Data were prepared by Kevin Faccenda in 2020.

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