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Plant-derived smoke: Old technology with possibilities for economic applications in agriculture and horticulture

M.G. Kulkarni, M.E. Light, J. Van Staden *

Research Centre for Plant Growth and Development, School of Biological and Conservation Sciences, University of KwaZulu-Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa

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Abstract

Fire and smoke have been used in traditional agricultural systems for centuries. In recent years, biologically active compounds have been isolated from smoke with potential uses in agriculture and horticulture. This article highlights the possibilities of using smoke-water or smoke-derived butenolide (3-methyl-*2H*-furo[2,3-*c*]pyran-2-one, termed karrikinolide, KAR_1) for the cultivation of agricultural and horticultural crops. Treatments with smoke-water show promising results for improving seed germination, seedling growth and crop productivity. In certain cases, even under adverse conditions, such as low or high temperatures and low osmotic potentials, smoke-water or a KAR_1 solution can promote seed germination and seedling growth. This phenomenon is of great significance when seeds are sown under drought conditions. Smoke-technology, therefore, has potential for use in arid and semi-arid regions. Possibilities may also exist for controlling some plant diseases and managing weeds with the use of smoke or KAR_1 solutions. In addition, smoke-technology can possibly economize the use of commercial chemical fertilizers, pesticides and herbicides, making it a feasible technology for organic farming and for resource-poor farmers in developing nations. The positive role of smoke-water in flowering and fruiting of crops cannot be overlooked as the karrikins found in smoke are now recognized as potential new plant growth regulators. Very low concentrations of smoke-water or a KAR_1 solution are effective in promoting germination and post-germination growth. Thus, early harvesting and increasing the productivity of crops using smoke-technology may be possible. Here we review some of the effects of smoke and KAR_1 on various crop species and discuss the potential uses of smoke technology in agriculture and horticulture.

Keywords: Crop plants; Germination; KAR_1; Karrikinolide; Productivity; Seedling growth; Seedling vigour

1. Introduction

Slash-and-burn techniques are practiced by many indigenous communities around the world for converting forests into crop fields. In Africa, pastoralists use fire to enhance the growth of grass for livestock and subsistence farmers use it to clear unwanted biomass before cultivating the next crop (GFMC, 2004). The use of fire is the cheapest, fastest and most effective method of land clearing and has an additional advantage of providing nutrients to the soil from ash residues (Simorangkir, 2007). Traditional Aborigines of Australia use fire for promoting the availability of economically important plants and animals (Gould, 1971; Hallam, 1975; Harris, 1977; Jones, 1969, 1980). Fires set by the Alyawara Aborigines of Central Australia cover a relatively small area but have a notably good influence on the productivity of *Ipomoea*, *Solanum* and different grass species. Thus, they are able to use fire as a low-cost method for cultivation (O'Connell et al., 1983). The majority of small-scale farmers in Samoa practice indigenous methods of pull-and-burn and fallowing to control weeds of taro, yam and taamu (Tikai and Kama, 2004). In Arunachal Pradesh of India, the ethnic Noctes tribe has maintained an age-old traditional slash-and-burn farming system on hill slopes (Tangjang, 2009).

In addition to the heat effects of fire, smoke plays a significant role in traditional agricultural systems. Resource-poor farmers in

* Corresponding author. Tel.: +27 33 2605130; fax: +27 33 2605897.
E-mail address: rcpgd@ukzn.ac.za (J. Van Staden).

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