EFFECT OF A NEW ORGANOSILICONE SURFACTANT ON DROPLET SPREAD

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Summary. The effectiveness of three surfactants, an organosilicone surfactant, a non-ionic surfactant and a surfactant containing extracts of yeast and molasses, were evaluated on rubber vine, *Cryptostegia grandiflora*. Six 1240 um droplets of a 0.2% (v/v) concentration of the three surfactants gave a 78, 6, and 3% leaf surface cover, respectively, on mature rubber vine leaves. The organosilicone surfactant would be ideal for low volume herbicide application as almost complete leaf coverage would be possible with only a small number of droplets.

INTRODUCTION

Polar and non-polar surfactants often facilitate and accentuate the surface modifying properties of herbicidal formulations (3).

There has recently been a trend towards the use of lower spray volumes. For instance, aerial applicators have reduced their spray volumes (6), and the growing popularity of the sprinkler sprayer (7), has allowed low volumes to be used with most herbicides. However, with low volumes sprays, plant coverage depends on carrier volume, droplet size, and the extent to which the individual drops spread over the surface after impact.

An organosilicone surfactant (Poly dimethyl siloxane: Pulse[R]) has recently been marketed in Australia. It has increased the effectiveness of metsulfuron and glyphosate on broom, *Cytisus scoparius*, and bracken, *Pteridium aquilinum* var *esculentum*, respectively (1,6). Field trials to assess herbicide efficacy using this surfactant are in progress. During the spraying of these trials, a characteristic wetting of leaves by the surfactant was observed. The objective of this paper is to quantify wetting of the leaves by measuring the spread of individual droplets. It should be noted that increased droplet spread is not the only way in which surfactants improve herbicide efficacy.

METHODS

Mature leaves of rubber vine were harvested just prior to testing, from the plants grown under a shade cloth for a period of 2-3 months. The leaves were checked for visible deformities or insect damage, and unsatisfactory leaves were discarded. Once collected the leaves were wiped clean to remove any foreign material not seen by the naked eye.

Varying concentrations of three surfactants were prepared. These were organosilicone surfactant (OSS) (Pulse[R]), non-ionic surfactant (NIS) (Nufarm Surfactant[R]), and a 55% yeast/25% molasses extract (v/v) (YMS) (Morwet[R]). The surfactants were made up in tap water which had a conductivity of 306 us/cm, total hardness of 138 mg $CaCO_3$/L (w/v) (E.D.T.A. titrimetric method was used), and pH 8.2.

Six 1 ul droplets, with and without surfactant, were applied to the leaves, which were made to lie as flat as possible by placing microscopic slides at the ends. Only one treatment was applied per leaf.

The spread of the droplets was recorded on the leaf with an acetone pen. the leaves were then carefully and accuractely drawn on an overhead projection sheet, and photocopies made of the pattern. The surface area of the spread was determined by a cut and weigh method. A standard curve was prepared by weighing known surface areas (20-3120 mm²) of photocopy paper. A correlation coefficient of 0.999 was obtained for the standard curve.

Dissipation of the droplets was observed during a period of 30 minutes. Phytotoxic effect of the surfactant droplets was noted after a period of 2 h.

RESULTS AND DISCUSSION

In the present work, surfactant effectiveness was evaluated by its effect on the spread of individual droplets. The leaf area covered per droplet without surfactant was 4.9 mm² (Fig. 1). The addition of OSS produced a large

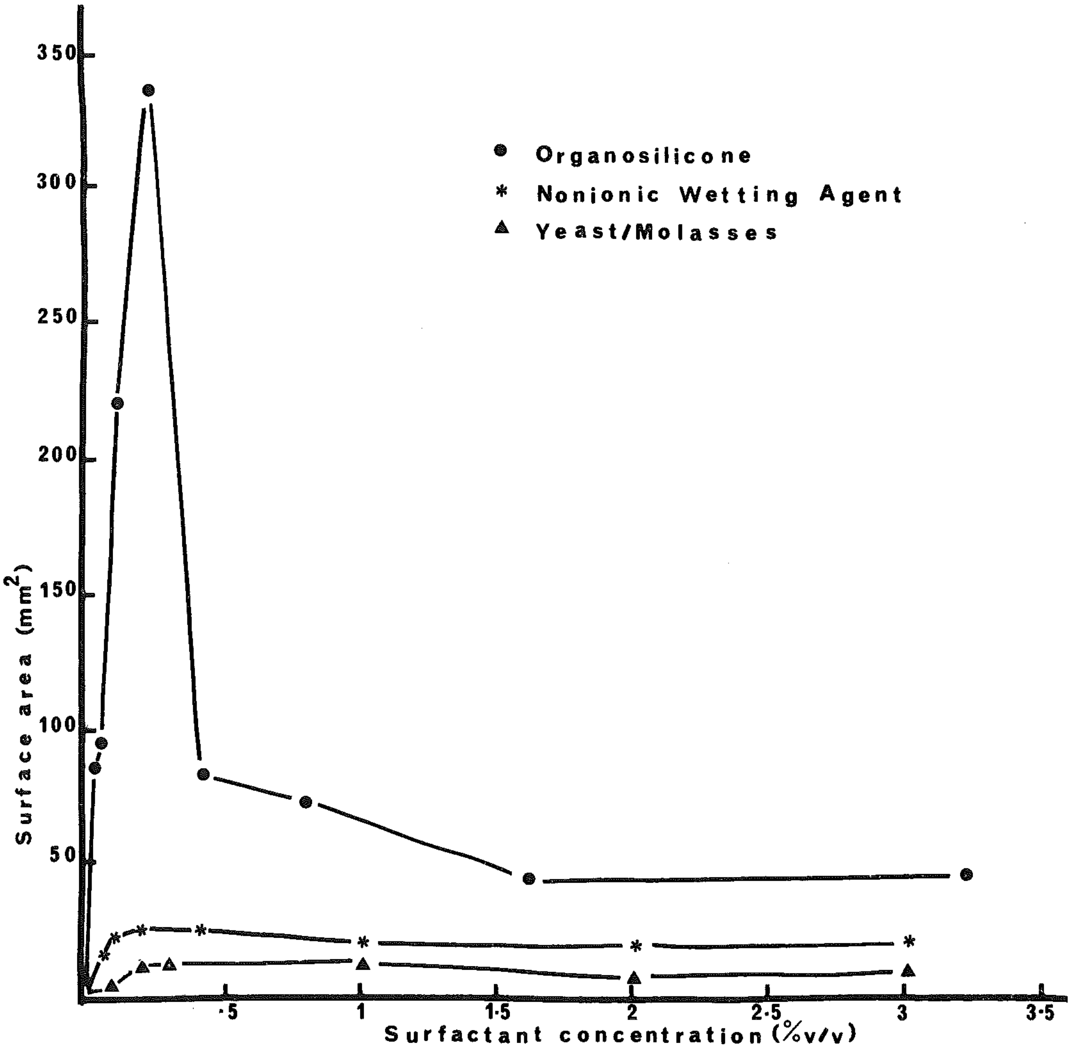

Figure 1. Effect of the concentration of three surfactants on the area of rubber vine covered by the mean of 1 ul droplets.

increase in droplet spread. Leaf area covered per droplet reached a maximum of 329.5 mm² at a concentration of 0.2% (v/v), but was then reduced sharply as a concentration was increased to 0.4%. Leaf area covered per droplet plateaued above a concentration of 1.6%. The droplet spread with the addition of the NIS and YMS also increased as their concentration was increased to 0.2% (v/v), but the leaf area per droplet was only 27.5 mm² and 14.8 mm² respectively. Concentrations of these two surfactants above 0.2% produced little change in the spread. At higher concentrations, most surfactants probably exist as strong colloidal systems (4).

Time of foliar uptake differed between the three surfactants. The leaves treated with the OSS appeared to absorb the droplet like a sponge. The OSS took 2-3 minutes for droplets to be absorbed into the leaf, while the NIS took over 10 minutes, and the YMS required greater than 20 minutes. The leaves treated with higher concentrations of all three surfactants contained a brown appearance at the site of application.

The mean surface area of the mature rubber vine leaves was 2548 $\pm$ 696 mm^2. A 1 *ul* droplet has a diameter of 1240 *um* (2). Six 1240 *um* droplets of a 0.2% OSS placed equidistant on a rubber vine leaf, covered 78% of the leaf surface. In comparison a 0.2% solution of NIS or YMS covered 6 and 3% of the leaf surface, respectively.

The OSS would make an ideal surfactant for low volume application of herbicides. Almost complete leaf coverage would be possible, requiring only a small number of droplets to hit the leaf. More herbicide would come into contact with the leaf surface enabling the possibility of greater foliar uptake, hence improved herbicide efficacy.

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