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Full Length Research Paper

Employing an adaptive neuro-fuzzy inference system for optimum distribution of liquid pesticides

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An adaptive neuro-fuzzy inference system (ANFIS) was implemented to evaluate different combinations of nozzle flow rates and boom heights in terms of liquid pesticide distribution uniformity from a ground field sprayer. In addition, the ANFIS was utilized to determine the optimum combination of the two principal factors (boom height and nozzle flow rate) that would result in the best distribution uniformity. In ANFIS, the two principal factors were selected as inputs, however, the Coefficient of Distribution Uniformity (CDU) was considered as the system output. For the tested set of data, the ANFIS analysis designated a boom height of 60 cm and a nozzle flow rate of 118 L/h as the optimum combination with a CDU value of 65.7%. Results of the study showed that the ANFIS technique was effective in evaluating and classifying the different possible combinations of the involved principal factors for best distribution uniformity. Moreover, results revealed that the utilized ANFIS was accurate in predicting the CDU. The R^2 values for the relationship between calculated CDU and ANFIS predicted CDU were 0.992 and 0.988 for the training and testing stages, respectively.

Key words: Pesticides, nozzle flow rate, boom height, ground field sprayer, adaptive neuro-fuzzy inference system, coefficient of distribution uniformity.

INTRODUCTION

The concerns of public and environmentalist about the bad effects that agricultural chemicals, such as pesticides, can cause to the environment are rapidly increasing. These concerns have led to an urgent need for judicious use of these pesticides in agriculture and more accurate pesticide field applications. It has been shown by a number of studies that the accuracy of liquid pesticide applications has mainly been affected by two factors; the flow rate out of the spray nozzles and the vertical distance between the spray boom and the treated surface (boom height). Therefore, researchers have, in many studies, investigated these two factors and revealed their effects on the accuracy of the spraying operations, which has to be maintained at a level that is satisfactory to farmers and environmentalists. Peterson et al. (1993) observed that the performance of a utilized spraying system was found to be greatly affected by the characteristics of the nozzle tip used, including droplet size, flow rate, spray angle and spray distribution pattern. On the other hand, boom height was reported to be the most significant variable in the prediction equation for the spray drift (Bode et al., 1976). They reported that even a small increase in the boom height (from 43 to 58 cm) could cause a major difference in the drift equation outcome, making it a very critical factor in predicting total drift and system accuracy. Drocas et al. (2009) reported that, for a ground field sprayer, the two most important factors affecting the liquid pesticide distribution uniformity were the boom height from the treated surface and the used nozzle type. For a specific pressure value, Faqiri

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Abbreviations: ANFIS, Adaptive neuro-fuzzy inference system; **CV,** coefficient of variation; **CDU,** coefficient of distribution uniformity; **RMSE,** root mean square error; **VAF,** variance account for.