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Le Corps professoral de

Gembloux Agro-Bio Tech - Université de Liège vous prie

de lui faire l'honneur d'assister à la défense publique de la dissertation originale que

Monsieur DE COCK Nicolas,

Titulaire d'un diplôme de master bioingénieur en sciences et technologies de l'environnement, à finalité spécialisée,

présentera en vue de l'obtention du grade et du diplôme de

DOCTEUR EN SCIENCES AGRONOMIQUES ET INGENIERIE BIOLOGIQUE,

le 9 novembre 2017, à 16 heures précises (personne ne sera admis après cette heure),

en l'auditorium GR (Génie Rural, bât. 2),

Passage des Déportés, 2 à 5030 GEMBLOUX.

Cette dissertation originale a pour titre :

« Conception d'une buse agricole à granulométrie étroite ».

Le jury est composé comme suit :

Président: Prof. P. LEJEUNE, Président du Département BIOSE,
Membres : Prof. F. LEBEAU (Promoteur), Prof. M. R. VETRANO (Copromoteur, KU Leuven), Prof. B. MERCATORIS (Copromoteur), Prof. S. DORBOLO, Prof. D. TERWAGNE (ULB), Prof. P. VERBOVEN (KU Leuven).

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Summary

Nowadays, pesticides use is necessary to satisfy the growing demand for agricultural products. During the field treatment one of the key parameters is the droplet sizes. Each kind of treatment has a droplet size which maximizes the spray application efficiency. However agricultural sprays have wide droplet size distribution because of their break up mode. This results in non-optimal application and therefore losses of product into the environment. This statement conducted the research as early as in the 60's to create the rotary atomizer. This device is able to produce narrow droplet size distribution using Plateau-Rayleigh break up mechanism. The characteristics of the produced spray by the rotary atomizer can be tuned by adjusting the rotational speed and the volumetric flow rate. Although offering agronomic and environmental qualities this has not met success for the application of plant protection products in field crops because of their cost, size and complexity.

The aim of the thesis was the design of a hydraulic nozzle with the rotary atomizer qualities and without the constraints of rotating parts. Unlike the rotary atomizer which has two control variables, the developed hydraulic nozzle will have a narrower operating range, thus a specific geometry has to be design for each kind of treatment. The thesis can be seen as a roadmap providing design tool at each step starting from the determination of an optimal droplet size according to the kind of treatment and ending with a nozzle geometry. The prediction of the optimal droplet size according to the treatment was done using integrated modelling approach of the spray transport and retention by the plant. As each spray requires a specific nozzle geometry, an analytical model of the flow on the nozzle was developed. This model allows the determination of geometry according to the desired spray. Finally, a prototype of nozzle has been built. The measurement of the spray characteristics of the prototype was realized using a developed high-speed imaging technique providing the droplet size and speed. The prototype showed results in term of narrowing of the droplet size distribution.