(DOI): 10.5935/PAeT.V6.N1.11

This article is presented in English with abstracts in Spanish and Portuguese

Brazilian Journal of Applied Technology For Agricultural Science, Guarapuava-PR, v.6, n.1, p.91-94, 2013

Technical note

Surface distribution of drops applied on the ground with sprayer

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Abstract

There are several factors that influence in the coverage percentage of the target: spray equipments, spray nozzle, adjuvants, weather conditions, soil topographic, etc. Based on this aspect, the uniformity of drop distribution on the target is the goal of the application technology. The aim of this study was to evaluate the horizontal drops distribution of a sprayer. It were distributed 396 water-sensitive papers, with a spacing of 1 m each, in a plain area of 12 x 33 m. Upon such papers was applied water through a hydraulic sprayer with 12 meters of bars. After the application, the water-sensitive papers were digitalized in a scanner and the obtained imaged analyzed the percentage of coverage by the Conta-Gotas® software. The data obtained were integrated and arranged in graphic, generating an image with five bands of coverage (0-20, 20-40, 40-60, 60-80 and 80-100%). It was verified a wide variation in the percentage of coverage along the pulverized area. The most part of the area (87.09%) had coverage between 40% and 80%. Thus, the results showed that even under appropriate operating conditions, applications with sprayer may not show uniformity.

Key-words: Coverage; pesticide; water sensitive papers

Distribuição superficial das gotas aplicadas sobre o solo com pulverizador de barras

Resumo

Diversos são os fatores que influenciam na porcentagem de cobertura do alvo: pulverizadores, pontas de pulverização, adjuvantes, condições meteorológicas, topografia do terreno, etc. Neste sentido, a uniformidade de distribuição das gotas é uma meta da tecnologia de aplicação. O objetivo deste trabalho foi avaliar a distribuição da cobertura de gotas sobre o solo a partir de um pulverizador de barras. Para isso, foram distribuídos 396 papéis hidrossensíveis, espaçados de um metro cada, em uma área plana de 12 x 33 m. Sobre tais papéis aplicou-se água por meio de um pulverizador hidráulico com 12 metros de barra. Após a aplicação, os papéis hidrossensíveis foram digitalizados em um scanner e as imagens obtidas foram analisadas no tocante a porcentagem de cobertura por meio do software Conta-Gotas®. Os dados foram integrados e dispostos em gráfico, gerando imagem com cinco faixas de cobertura (0-20, 20-40, 40-60, 60-80 e 80-100%). Foi verificada uma grande variação nas porcentagens de cobertura ao longo da área pulverizada. A maior parte da área (87,09%) teve cobertura variando entre 40% e 80%. Assim, os resultados demonstraram que, mesmo sob condições operacionais adequadas, as aplicações com pulverizadores de barras podem não apresentar uniformidade.

Palavras-chave: Cobertura; produto fitossanitário; papel hidrossensível

Distribución superficial de las gotas aplicadas en el suelo con pulverizador de barra

Resumen

Existen varios factores que influyen en el porcentaje de cobertura de los pulverizadores: puntas de pulverización, adyuvantes, las condiciones climáticas, la topografía, etc. En este sentido, la uniformidad de la distribución de las gotas es una meta de la tecnología de aplicación. El objetivo de este estudio fue evaluar la distribución de las gotas sobre el terreno a partir de un pulverizador de barra. Para ello, se distribuyeron 396 papeles hidrosensibles, apartados por un metro cada uno en área

Received in: 10/06/2012 Accepted for publication: 08/03/2013

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plana de 12 x 33 m. Sobre estos se aplicó agua por medio de pulverizador hidráulico con barra de 12 metros. Después de la aplicación, las tarjetas hidrosensibles fueron digitalizadas en un escáner y las imágenes evaluadas a respecto del porcentaje de cobertura a través de software Conta-gotas®. Los datos fueron integrados y dispuestos en gráfico, generando imagen con cinco bandas de cobertura (0-20, 20-40, 40-60, 60-80 y 80-100%). Se verificó una gran variación en los porcentajes de cobertura al largo del área. La mayor parte del área (87,09%) tuvo cobertura entre 40% y 80%. Por lo tanto, los resultados indican que, incluso bajo condiciones de funcionamiento adecuadas, las aplicaciones con pulverizador de barra pueden no tener uniformidad.

Palabras clave: cubierta, producto fitosanitario, papel hidrosensible

Introduction

The main goal of the technology of phytosanitary products application is to deposit the correct quantity of active ingredient on the target, with maximum efficiency, in a economic way, affecting the minimum possible the environment in which is inserted (MATTHEWS, 2008). Based in this premise, innumerable points inherent to application of technology have been studied. Among them are mainly: spray nozzles, application rate, air assistance in the spray bar, adjuvants use, among others. All are linked to different characteristics of the product, of target and weather conditions during the operation. The drift of the phytosanitary products reduces the efficiency of the control and is source of environmental contamination, being considered one of the factors most studied in the context of application oftechnology, because it is associated mainly to interaction between the meteorological conditions and size of the pulverized drops.

The use of greater drops and of adjuvants can reduce the possibility of drift (COSTA et al., 2007; BUTLER ELLIS et al., 2004), yet, greater levels of coverage on the target, aiming improvement in the efficiency of control of phytosanitary products are obtained with the use of smaller drops due to the greater quantity of pulverized drops associated to its bigger specific surface.

In this sense, BALAN et al. (2005) relate the importance of the correct choice of the pulverization nozzle in function of the temperature and relative humidity of the air, needing to be attentive primarily to the meteorological conditions in applications which require thin or very thin droplets, it can even interrupt the application in non favorable conditions.

Beyond this mentioned factors, the type of sprayer, pulverization nozzles, work speed, bar high in relation to the target, the characteristics of the target and the topographic situation of the terrain are examples of factors which can be considered, mainly in bar sprayers, when is aimed the obtaining of appropriate levels of coverage.(MATTHEWS, 2008; CAMARA et al., 2008; CUNHA et al., 2007; VIANA et a., 2007). QUEIROZ (2001), studying pulverizations in forest cultivation, found great horizontal and vertical oscillations of the pulverization bar, while SUGUISAWA et al. (2007), evaluating the percentage of coverage in wheat leaves, verified great variations between the percentages during the application.

In function of these arguments, this study had as objective evaluate the coverage distribution of droplets on the soil, from a the pulverization bar.

Material and Methods

The study was done in the school farm of the State University of Londrina (23°20´30´´S 51°12´35´´W), with a proximity altitude of 560m. It was used a plain area of earthworks (compacted soil) aiming to guarantee good conditions of stability to the sprayer. The delimitated area was constituted of 14 x 35 meters. In this area were disposed 490 water sensitive papers, a meter spaced, fixed in the soil through a nail in its center.

It was used an hydraulic sprayer Condor AM12 (bar of 12 meters and nozzles with 0.5 of spacing). The application was done using only water, with a bar put at a height of 0.5 meters from the soil, at a speed of 6 km h^{-1}. The spraying nozzles used were ADI04 (plain jet with pre-orifice), generating in the studied work pressure, according to the manufacturer, droplets classified as medium and thick. During the application, the weather conditions relative to air temperature, humidity relative and wind speed were of 29 °C, 63% and 3,2 km h^{-1}, respectively.

The water sensitive paper, previously identified as their position, were collected and packaged in plastic wrap soon after the application, to avoid contamination by the environment humidity. Subsequently, each water sensitive paper was digitalized with 300 dpi of resolution, generating and analyzed image as for the coverage percentage by the software Conta-Gotas® (CANTERI et al., 2001).

The water sensitive papers of each lateral of the delimitated area, considered as border, were neglected, thus being a useful area of 12 x 33 m, which totalized a sample of 396 water sensitive papers. The data obtained were integrated and disposed in a graphic, through the available resources in the Sigma Plot® program, generating images with five stripes of deposition 0 to 20, 20 to 40, 40 to 60, 60 to 80 and 80 to 100%. Finally, through the images analysis program SIARCS 3.0® (JORGE et al, 1996), was qualified each interval of the coverage percentage.

Results and Discussion

The result of the horizontal distribution of the coverage percentage of the droplets can be observed in Figure 1 in the form of graphic representation.

The horizontal distribution of coverage percentage of the water sensitive papers was shown to be variable, not presenting uniformity. The expectation was that the distribution of the coverage percentage on the water sensitive papers on the soil would tend to uniformity, which did not happen. This was presumed, because the droplet size used in the application (medium to thick) was less subjected to drift (CUNHA et al., 2007; BALAN et al., 2005) and the conditions for the spraying were considered adequate, in function of the weather conditions at the moment of the application, regular surface of the terrain and the sprayer speed (MATTHEWS, 2008).

The wind did not influenced in the coverage percentage on the water sensitive papers on the soil, because it is not seen a tendency to greater or lesser coverage on a determined side of the pulverized area, which was to be expected if the influence occurred. Now, the vertical movement of the bar during the shifting is maybe the predominant factor for the verified variation, promoting a greater coverage as closer to the soil. It is attributed this fact to the lesser coverage percentage on a certain side of the pulverized area in detriment of the greater coverage on the other side, altering this behavior during the whole time of the sprayer shifting as for its respective sides.

QUEIROZ (2001), studying the vertical movement of the bar during the shifting of the sprayer, starting from digital videography, in conditions of forest cultivation, found oscillations in the sprayer bar edges of until 1.78 m (horizontal) and 1.92 m (vertical). The results show, especially, that even with the maximum care at the application moment, there is a variation of the sprayer distribution.

The distribution of the applied sprayer coverage in targets of water sensitive paper, obtained in intervals of 20%, can be observed in Table 1.

Table 1. Represented area of each coverage percentage range and in accumulated area.

Coverage range (%)	Represented area (%)	Accumulated area (%)
0 - 20	3.11	3.11
20 - 40	9.12	12.23
40 - 60	42.43	54.66
60 - 80	44.66	99.32
80 - 100	0.68	100

Coverage varying between the ranges of 40 to 60% and 60 to 80% represent the bigger part of the applied area, around 87%. Analyzing separately each one of the coverage ranges (40 to 60% and 60 to 80%), it is verified that they are practically equivalent with regard to the area represented. The remainder of the sprayed area,, around 13%, had its representativeness distributed as follows: 3.11% (range between 0 to 20% of the coverage; 9.12% (range of 20 to 40% of coverage); 0.68% (range of 80 to 100% of coverage).

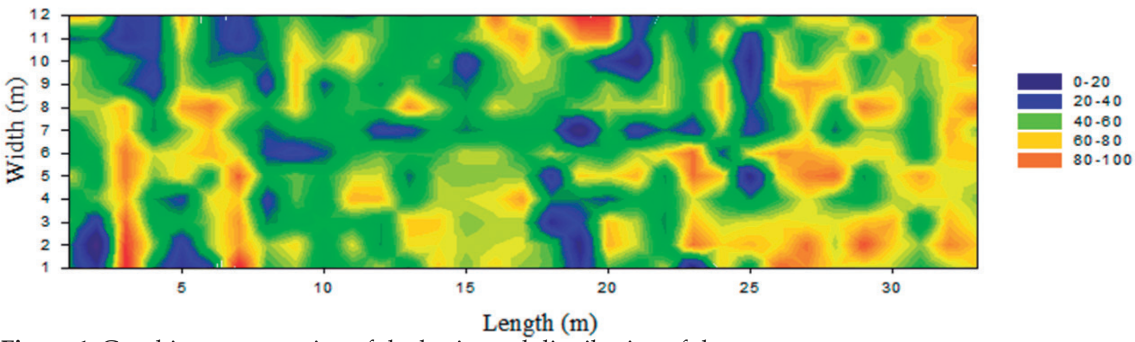

Figure 1. Graphic representation of the horizontal distribution of the coverage percentage.

SUGUISAWA et al. (2007) evaluating the distribution of the coverage percentage, in a wheat crop, found values of 43% of distribution with coverage between 23 and 37%, and 45% of the distribution with coverage between 37 and 64%. With regard to the coverage percentage, is hard to establish an ideal range for an efficient application, because various factors influence, since the used product characteristics, target type, the weather conditions after the application, among others, however products of contact need coverage values higher than the systemic products.

Conclusion

Based in the percentage of coverage verified, it is concluded that exists variation in the superficial distribution of the droplets on the soil at the moment of the pulverization, and can be inferred through such fact that the quantity of the applied product on the soil is given in a heterogeneous way, i. e. greater doses are applied in certain locations than in others.

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