METHOD TO DETERMINE UNSUITABLE DAYS FOR AGRICULTURAL SPRAYING

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SUMMARY: Nowadays, the erratic weather makes it difficult to apply agrochemicals through the spraying procedure. The irregular agro-climatic conditions prevent or restrict the application through mechanized spraying, since they negatively affect factors such as the quality of the application, the operational and economic performance, and the agricultural planning and management. The aim of the current study is to validate a methodology able to accuracy the useful days unsuitable for agricultural spraying. The methodology is valid, because, despite the existing different agro-climatic conditions, it precisely defines the unsuitable useful days for spraying.

Keywords: Agricultural meteorology. Agricultural mechanization. Time available. Planning and management. Agrochemical application engineering.

MÉTODO DE DETERMINAÇÃO DE DIAS IMPRÓPRIOS PARA PULVERIZAÇÃO AGRÍCOLA

RESUMO: Nos dias atuais o clima tem sido irregular, tornando difícil realizar as aplicações de defensivos agrícolas, como é o caso da pulverização. A influência da irregularidade das condições agroclimáticas causa impedimento ou restrição para execução da pulverização mecanizada, ao tempo que interfere negativamente nos fatores da qualidade de aplicação, de desempenho operacional, econômico e no planejamento e gerenciamento agrícola. O trabalho tem o objetivo de validar uma metodologia para precisar os dias úteis impróprios para pulverização agrícola. A metodologia é válida, porque em diversas condições agroclimáticas que possam existir, irá definir com precisão os dias úteis impróprios para pulverização.

Palavras-chave: Agrometeorologia. Mecanização agrícola. Tempo disponível. Planejamento e gerenciamento. Engenharia de aplicação de defensivos

INTRODUCTION

Nowadays, the erratic weather makes it difficult to perform spraying operations. Spraying is a mechanized agricultural operation that does not depend solely on the use of machines. It mainly depends on agro-climatic factors, since spraying is directly influenced by wind speed, air temperature and relative humidity air (ANTUNIASSI, 2005; BALASTREIRE, 1990; JACTO, 2001; SHIRATSUCHI ; FONTES, 2002; SAAB, 2004).

The influence of agro-climatic factors prevents or restricts the performed of spraying operations. The operations in the mechanized agriculture are performed through estimates of time available (MIALHE, 1974), which lead to inaccuracy in the measurement of the time available to perform the spraying operations, since the useful day unsuitable are only subjectively estimated.

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The inaccuracy in the time available is striking, since it negatively influences variables such as the quality of the agrochemical application, the operational and economic performance, and the decision-making by agricultural companies. Therefore, the aim of the current study is to validate a methodology able to accuracy the useful unsuitable days for agricultural spraying.

MATERIAL AND METHOD

The current study has taken into consideration propositions developed to meet such aim, since such propositions comprised agro-climatic parameters such as wind speed, air temperature and relative air humidity. The propositions were prepared according to the technical recommendations, such as maximum wind speed at 10 km h^{-1}, suggested by Balastreire (1990); Jacto (2001); Shiratsuchi ; Fontes (2002); and to the maximum air temperature at 30°C and minimum relative humidity air at 50%, proposed by Antuniassi (2005); Saab (2004); Shiratsuchi ; Fontes (2002).

The developed propositions have set the wind speed, air temperature and humidity air relative indexes, useful day unsuitable for spraying and the number of useful unsuitable day for spraying. The wind speed index (WSI) was calculated based on the ratio between wind speed (WS) and maximum wind speed constant, equation (1).

$$WSI = \left(\frac{WS}{10}\right) \quad (1)$$

Wherein:
WSI: wind speed index;
WS: wind speed (km h^{-1});
10: maximum wind speed constant (km h^{-1}).

The air temperature index (ATI) was defined based on the ratio between air temperature (AT) and maximum air temperature constant, equation (2).

$$ATI = \left(\frac{AT}{30}\right) \quad (2)$$

Wherein:
ATI: air temperature index;
AT: air temperature (°C);
30: maximum air temperature constant (°C).

The relative humidity air (RHA) was set based on the ratio between actual water vapor pressure (e_a) and saturation water vapor pressure (e_s), according to the proposal by Monteith and Unsworth (1990), equation (3).

$$RHA = \left[\left(\frac{e_a}{e_s}\right) * 100\right] \quad (3)$$

Wherein:
RHA: relative humidity air (%);
e_a: actual water vapor pressure;

e_s: saturation water vapor pressure;
100: conversion factor.

The relative air humidity index (RAHI) was calculated according to the ratio between relative humidity air (RHA) and minimum relative air humidity constant, equation (4).

$$RAHI = \left\{ 1 - \left[\frac{\left(\frac{RHA * 100}{50} \right) - 100}{100} \right] \right\} \quad (4)$$

Wherein:
RAHI: relative air humidity index;
50: minimum relative air humidity constant (%);
100: conversion factor.

The useful day unsuitable for spraying (Udus) was defined through the arithmetic mean between wind speed index (WSI), air temperature index (ATI) and relative air humidity index (RAHI), equation (5).

$$Udus = \frac{WSI + ATI + RAHI}{3} \quad (5)$$

Wherein:
Udus: useful day unsuitable for spraying;
3: number of indexes.

The number of useful unsuitable day for spraying (Nuuds) was set through the association between useful day unsuitable for spraying (Udus) and total number of days (Tnd), equation (6).

$$Nuuds = Udus * Tnd \quad (6)$$

Wherein:
Nuuds: number of useful unsuitable day for spraying;
Tnd: total number of days.

The number useful unsuitable day for spraying (Nuuds) should be taken into consideration in the time available, according to the methodology by Mialhe (1974), in order to accuracy the spraying operation time, equation (7).

$$TA = \{ [Tnd - (Nsph + Nuuds)] * Wh \} \quad (7)$$

Wherein:
TA: time available (h);
Tnd: total number of days;
Nsph: number of sundays and public holidays;
Nuuds: number of useful unsuitable day for spraying;
Wh: working hours (h).

RESULT AND DISCUSSION

The propositions of the herein considered methodology were analyzed through manually performed calculations that have led to results consistent with reality. According to the calculations, it is not recommended to perform spraying operations whenever the wind speed, air temperature or relative

humidity air indexes are higher than or equal to 1.0, since such value does not meet the agro-climatic recommendations for agrochemical applications. Thus, the spraying operation should not be carried to avoid the inefficient in the application, high agrochemical losses, or even environmental accidents.

CONCLUSION

It is possible concluding that the herein analyzed method is reliable, adequate and valid. Thus, it may be used to accurately set the time available for spraying operations, according to Mialhe (1974). Therefore, it is an instrument that may be used by technical professionals, education, research and extension institutions, farmers and agricultural companies.

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