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ANALYSIS OF DISTRIBUTION OF ADDITIVES IN ROUND BALES OF MOIST HAY

Sylwester Borowski

University of Technology and Life Sciences
ul. Kaliskiego 7, 85-796 Bydgoszcz, Poland
tel.: +48 52 3408208, fax: +48 52 3408208
e-mail: sylwa@utp.edu.pl

Abstract

This article shows the results of studies regarding the distribution of microbiological additive Inoculant 1155 in bales of moist hay formed in round baler. Its greatest amount was observed in the central part of a bale. An improvement of the irregularity index was observed during storage. The reproduction of bacteria reduces the negative effects of errors while applying the preparation. The applied technology assures obtainment of the good quality of the fodder from moist hay without energetistic stocks on his drying.

Keywords: *alfalfa, microbiological additives, moist hay*

1. Introduction

Application of conservation additives in hay harvest technology enables hay harvest from alfalfa with increased moisture content. The enlargement moisture harvested hay it is allowed from 15 to 24 % [5, 9]. This method of moist hay conservation is energy saving which provides gaining more dry matter and feed from one hectare [1, 7].

Effectiveness of the additive depends on its given amount distribution in the harvested hay, especially in the form of a round bale [3], [4]. Existence in the bale of moist spots which have no contact with the additive can lead to formation of harmful bacteria clusters which can cause destruction of the whole bale or even its self ignition. So the harvested fodder can be harmful for animals [6].

The paper aims at analyzing non uniformity of microbiological granulated material distribution in a bale of moist hay.

2. Material and methods

The plant material used for the tests was alfalfa (*Medicado media*) in the phase of its blossom beginning. The hay moisture while harvesting was 22%. The average crop of the green matter was for I swath 440 q ha. Microbiological granulated preparation Inoculant 1155, produced by Pioneer company, was being added to moist hay. The additive was applied in the amount of 1 kg per 1 tones. It contained drought of natural bacteria *Bacillus spp.* and calcium carbonate. This is the bacterium stepping out on plants of lucerne however in small quantities. The additive had the following properties: the average radius of granules 0.87mm; moisture content of 2.5%; density of

1040 kg m^{-3}; number of living bacteria in colony forming units (cfu) 108 cfu g^{-1} (the number guaranteed by the producer). The preparation was being added by means of an applicator Gandy Jumbo (Fig. 1), mounted to a round baler Z-279/1.

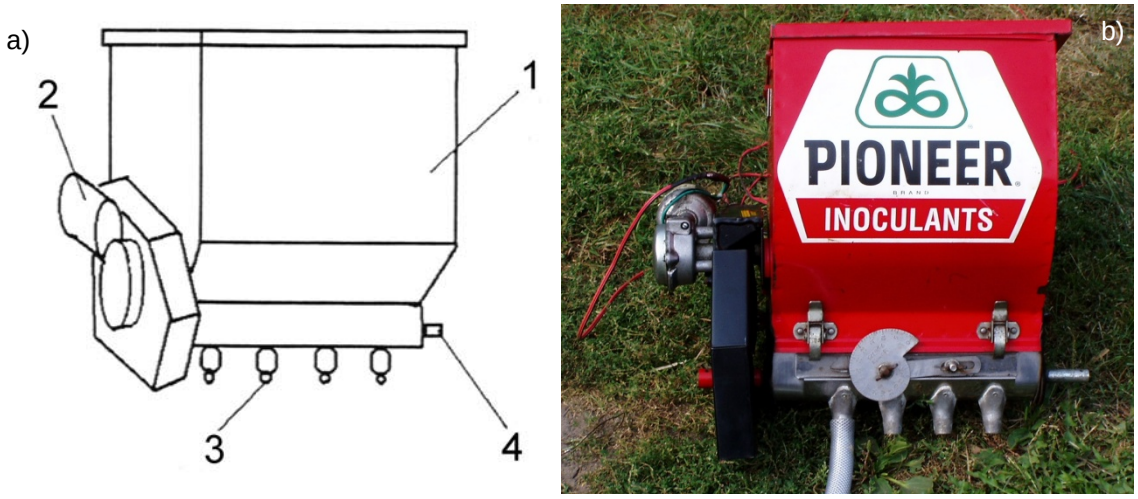

Fig. 1. Applicator "Gandy Jumbo": a - the scheme, b - view, 1 - the bulb of the preparation, 2 - electric engine with chain transmission, 3 - nozzles, 4 - the shaft raking out

The assessment of the preparation distribution non uniformity was performed with the use of two methods:

- **directly** through an analysis of the preparation marker particles, for the samples of hay taken from bales, just right after the harvest; the assessment was made in cooperation with the Department of Chemical Engineering and Environment Protection. A method of marking biologically active preparations with n-hexane, developed specially for this research, was used. Samples were taken from 15 places of the bale.
- **indirectly**, through quantitative assessment of *Bacillus pumilus* bacteria samples of hay taken 15 days after harvesting from 5 different places of bales according the scheme of single envelope [2]. The amount of bacteria was made in the Department of Microbiology at the University of Technology and Life Sciences [8].

Uniformity of the additive distribution in the hay was characterized by a mixing non uniformity index (variability coefficient) K:

$$K = \frac{\varphi}{\bar{x}} \cdot 100 \ \%, \tag{1}$$

where:
φ - standard deflection,
$\bar{x}$ - mean arithmetic content.

3. Results and discussion

The results are presented in the form of histograms in Figure 2.

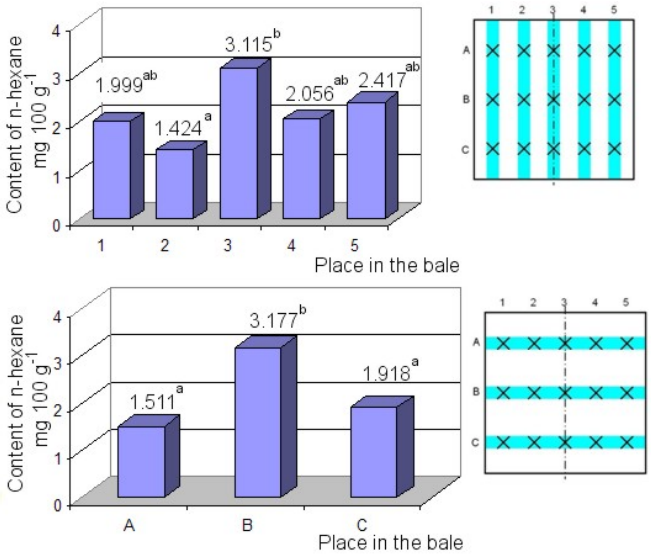

Fig. 2 Histograms of n-Hexane content in hay samples (mean value). a, b - differences are statistically significant with relevance level p≤0.05

As figure 1 demonstrates, the measurement, vertical planes 1,3,4,5 do not vary significantly from each other in terms of n-Hexane content. No statistically significant differences between vertical planes 1,2,4,5 were found, either Smallest Difference of Significance ($NIR_{0.05}$ = 1.136). The differences occurred only between vertical planes 2 and 3. It indicates small differences in the amounts of the applied preparation. Statistical differences between horizontal planes A and C were not found. Horizontal plane B was different ($NIR_{0.05}$ = 0.749) from the other ones, and the highest amount of n-Hexane was found in some places, there. The calculated index of distribution non uniformity was K_1 = 61.1 %.

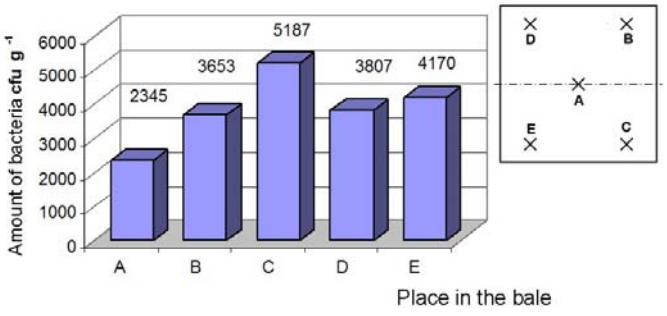

Fig. 3 Amount of bacteria in hay samples obtained in the studies (mean value)

As figure 2 shows, the smallest number of bacteria was found in the middle of the bale (point A) whereas higher values were found in its external layers. Apart from all the significant differences between the number of bacteria in the examined samples, the statistical analysis did not revealed differences. For relevance level p≤0.05 the Smallest Difference of Significance ($NIR_{0.05}$) was 3166 cfu g^{-1}. The calculated index of bacteria distribution non uniformity (variability coefficient) was K_2 = 53.9 %.

4. Conclusion

- Chemical assessment showed that the best quality feed resulted when the hay had a moisture content of 22%.
- The biggest amount of the preparation was found in the middle part of the bale. An influence of the bale local thickness on its content has been observed.

- Multiplying bacteria can penetrate a bale of hay, occurring in bigger amounts in moist places. Their behavior makes it possible to minimize application errors which affect the preparation distribution uniformity in the bale.
- Improvement of the preparation distribution non uniformity index has been observed.

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