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ORIGINAL ARTICLE

Impact of the Baler Chamber pressure on Alfalfa bale density and Penetration Resistance

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ABSTRACT
Alfalfa hay bale weight and density are considered as important parameters characterizing the produced bales. Therefore, a study was carried out for the assessment of the impact of the baler chamber pressure on alfalfa hay bales produced by a large rectangular baler in terms of bale weight, density and penetration resistance. The study was conducted in a farm located in the eastern region of Saudi Arabia. Results indicated that the increase in the baler chamber pressure associated with a significant increase in alfalfa bale dry weight; hence, bale dry density (R^2 = 0.84, P-Value = 4.23E-5), as well as a significant increase in the average bale penetration resistance (R^2 = 0.75, P-value = 0.053). The mean dry weight of 278.0, 298.5 and 318.2 kg, with mean bale dry densities of 150.5, 161.6 and 172.2 kg m^{-3}were recorded for the bales produced under baler chamber pressures of 5000, 6000 and 7000 kPa, respectively. On the other hand, the average penetration resistance of the produced bales through the entire penetration depth (0-45 cm) was 736.9, 789.6 and 1028.7 kPa for baler chamber pressures of 5000, 6000 and 7000 kPa, respectively.
Keywords: *Alfalfa hay, rectangular baler, baler chamber pressure, penetration resistance*

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INTRODUCTION

Alfalfa (*Medicago Sativa*) is an important forage crop for dairy farms to feed animals because of its high protein contentand other nutrients andhigh digestibility [1]. The immediate problem which faces farmers after cutting alfalfa for producing hay is to store the produced hay in a safe manner. Hence, high amount of moisture must be removed from the harvested grass before storing the hay. Different kinds of machines can be used for this purpose, such as tedders, turners, side-delivery rakes, rollers and crimpers [2].After hay becomes dry, a swather machine is usually used to swath the hay into rows for preparing it for the final baling process. Baling hay is one of the essential operations performed to facilitate handling, storing and transporting the harvested hay. In addition, field baling of harvested forages is a high-capacity and one man operation with low harvest losses [3]. Balers are designed to pick up hay or straw from a swath, compress it to specific dimensions and tie each bale with twine [2].The hay bale density is a function of the type of the material and its moisture content and the total resistance applied on the material through the baler chamber. The principal method to control the bale density is by squeezing together two sides or four sides at the discharge of baler chamber [3].Large rectangular balers, which are commonly used for hay baling, greatly vary based on their feeding mechanism. Lotjonen and Paappanaen [4] reported that large square baler with a pre-compression chamber resulted in the best shaped and densest bales for red canary grass. In large round balers, the most important factor that affects the bale density is the bale chamber pressure, even when using different forward speeds and different windrow sizes. In round baling, there are a few studies focused on baling very dry and coarse material; however, most studies focused on silage baling, where the material is softer with high moisture content (40-75%).
The most important parameters characterizing the produced hay bales are the bale weight, density and nutrient content. Sun et al. [5] developed a dual sensor penetrometer to simultaneously measure