Late ripening in wheat types as a tool to improve the yield and quality of hay in ruminants' nutrition

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Including forage in the diets of ruminants is essential for maintaining proper rumen function, animal health, and overall nutritional balance. A substantial proportion of forage crops in Israel are unirrigated crops, predominantly various wheat species and legumes. These crops depend entirely on the annual distribution and quantity of precipitation. During hay production, the harvested biomass undergoes a wilting period of approximately two weeks, and in some cases longer. Throughout this period, the material is exposed to rainfall events that may cause spoilage, markedly diminishing its nutritional value and, in severe cases, rendering it unsuitable for ruminant feeding. In recent years, forage production in Israel—particularly hay—has been adversely affected by heavy rainfall during the wilting stage across multiple regions. Under extreme conditions, producers were compelled to use low-quality hay, in some instances entirely unsuitable for feeding, even in rations formulated for high-producing dairy cows. These circumstances underscore the need to evaluate, from an agronomic and nutritional perspective, the potential integration of late-maturing cereal cultivars specifically targeted for hay production. The present study aimed to systematically assess a diverse set of newly bred late-maturing cereal lines for their suitability for local hay production. We hypothesized that it would be possible to identify late-maturing, high-yielding cultivars with superior nutritional quality for ruminants, allowing for harvest later in the season—after or near the end of the rainy period—and thereby substantially reducing the risk of rainfall damage during the wilting period. Over the first two years of the study, 13 cereal cultivars were grown under controlled conditions at the Gilat Research Center: two spelt varieties, two emmer wheat varieties, two traditional late-maturing durum types (Norsi and Horani), a Kamut cultivar, three late-maturing wheat breeding lines (winter × spring wheat derivatives), and three commercial cultivars (Mispo 37, Gadish—a widely used early-maturing dual-purpose variety—and 9C, a durum type). Phenological parameters, including heading date and biomass accumulation, were recorded. Approximately 140 hay samples were sent to a U.S. laboratory for chemical and formula-based nutritional analyses. Substantial phenological variability was observed, with heading dates differing by up to 2.5 months among lines. Biomass yields also varied considerably, with some lines producing nearly double the biomass of others. Differences of up to 3% in crude protein concentration and 12–13% in NDF and ADF concentrations were detected. In addition, 48-hour dry matter and NDF digestibility were quantified, enabling calculation of digestible dry matter and digestible NDF yield per dunam. Several lines exhibited notably high yields of digestible dry matter combined with moderate

lateness—for example, Norsi—although these lines displayed relatively low NDF concentrations. Integrating agronomic and nutritional considerations, two late-maturing cultivars were selected for a feeding trial, with the early-maturing Gadish serving as the control. In the third year, the three selected cultivars—Gadish, Mispo 37, and Kamut—were grown in the Jezreel Valley to produce hay for an 11-week controlled feeding trial using individually fed dairy cows in the Volcani Institute. All cows received isonitrogenous and isoenergetic rations in which the tested hays comprised approximately 14.3% of dietary dry matter. Milk yield, fat-corrected milk (FCM), energy-corrected milk (ECM), and income-over-feed-equivalent milk were all higher in cows fed the Kamut hay, as was milk fat percentage. Production efficiency was markedly improved as well, with Kamut showing up to a 9% increase in efficiency relative to the Gadish control. Rumen fermentation parameters did not differ significantly among treatments. Digestibility coefficients revealed higher dry matter, organic matter, and fat digestibility in cows fed Mispo 37, while NDF and ADF digestibility were greater in the Gadish cows. Such discrepancies between digestibility measurements and productive performance are not uncommon in nutritional research and may reflect post-absorptive metabolism or differential nutrient partitioning between body tissues and milk synthesis. In the present study, cows consuming Kamut allocated more absorbed nutrients toward milk production and fewer toward body tissue deposition, as reflected in their lower body weight gain. In conclusion, Kamut appears to be a promising alternative to widely used early-maturing cultivars such as Gadish and may significantly reduce the risk of rainfall-related losses during hay wilting. Kamut demonstrated high biomass yield, elevated NDF content with favorable digestibility characteristics, and superior performance in the feeding trial, both in milk production and efficiency metrics. Based on these findings, we recommend considering Kamut as a viable replacement for current early-maturing cultivars used in hay production.