The Integration of Whole Crop Cereal Silage into Pastured-based Dairy Systems

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Submitted in total fulfilment of the requirements of the degree of Doctor of Philosophy

October 2011

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Abstract

Failure to meet the year-round nutritional requirements of genetically improved dairy cows has led to a need to evaluate complementary forage such as whole crop cereal in enhancing home-grown forage yield, utilization and production response from dairy cows.

This thesis demonstrated that cereal crop triticale and wheat can be an alternative feed resource in pasture based production systems. The thesis identified that most cereal crops can offer as early grazing option, is robust in DM yield and flexible in utilization beside clear trade-off benefits from pasture in terms of harvestable nutrients. This was evident from the DM yield and nutrient composition of crops in first study at booting (GS34) where triticale (cv. Crackerjack) had potential of 4.29 metric tons DM and while wheat (cv. Wedgetail) had 3.66 metric tons DM. CP concentration was 206 g per kg DM and 245 g per kg DM with 10.5 MJ ME per kg DM and 10.7 MJ ME per kg DM for triticale and wheat at GS34 respectively. Delaying harvest for silage (GS84) yielded 15.81 metric tons DM by triticale and 13.18 metric tons DM by wheat. Meanwhile WSC concentration at GS84 for triticale crop had reached to 208 ± 25 g per kg DM and wheat was 175 ± 32 g per kg DM. Triticale had potential to harvest 129 GJ ME per hectare and wheat had 109 GJ ME per hectare at GS84. Whole crop cereals produced quality silage in storage with pH 3.09 to 4.40 with moderate energy values of 8.92 ± 0.07 MJ ME per kg DM for triticale silage and 9.40 ± 0.01 MJ ME per kg DM for wheat silage.

Fermentation process of whole crop triticale and wheat with silage additives produced good quality silage while ensiling method by direct-cut technique was most appropriate for whole crop. Application of homo-fermentative SilAll additive was most efficient to produce LA (70.7 to 113.8 g/kg DM) while hetero-fermentative LaSil additives were effective to yield maximum AA (28.2 to 40.8 g/kg DM). The ME value of direct-cut silage of triticale and wheat was still better with 10.7 MJ per kg DM and 10.4 MJ per kg DM compared to 9.4 MJ per kg DM and 10 MJ per kg DM from wilted silage
respectively. However, direct-cut silage had higher proteolysis effect with 9.3 to 12.3 g per kg total N compared to 7.3 to 9.6 g per kg total N from wilted silage.

Whole crop triticale and wheat were comparable in degradability quality offering options in dry-land farming. The extent of triticale silage degradability at GS34 was 135 to 323 ml per g DM for direct-cut method silage while wheat silage was 204 to 257 ml per g DM. The extent of wilted triticale silage got reduced to 86.5 to 116.6 ml per gram DM while it was 105 to 116 ml per g DM for wilted wheat silage. However the rate of degradation of direct-cut silage was longer with 14 to 18 hours in both forage crops. On contrary, maximum time taken for wilted silage degradation was within 6 to 9 hours for both forage crops. The total fermentation acid production from silage digestion was 11.8 to 14.46 mmol per L from both crop species ensiled by either method.

Feeding WCS along with other forages demonstrated to support mid to late lactation cows without limitation to intake and production response. WCS intake of 3.71 to 4.02 kg DM was significant (p<0.001) with canola hay compared to 3.26 to 3.86 kg DM to pasture hay. WCS wastage accounted 9 to 23 percent on pasture hay while on canola hay wasted 6 to 12 percent only. WCS intake rate (g/minute) was higher (37.74 g/minute) to canola hay while it was only 34.96 g per minute on pasture hay. Yet the bite size of WCS was within 1.1 g per bite for both. The total VFI were similar with 18.95 to 20.62 kg DM for pasture and 19.39 to 20.61 kg DM for canola hay.

Mean milk yield of 16.1 ± 2.85 kg per day from canola hay group cows was significant (p<0.01) from 13.9 ± 2.58 kg produced by pasture hay group cows. However the total milk solids produced from pasture group (1265 g/day) was not significant to canola group cows (1345 g/day). The ME and MP supply from the total VFI far exceeded nutrient requirement indicating good complementarity of ration with WCS. Mean LW gain was 1.16 to 1.54 kg per day for pasture while canola hay gained only 670 g per day with full allowance of wheat grain. BCS in pasture hay gained 0.08 to 0.48 points while it was 0.06 to 0.28 points gain for canola hay.