Utilizing unsupervised learning to improve sward content prediction and herbage mass estimation

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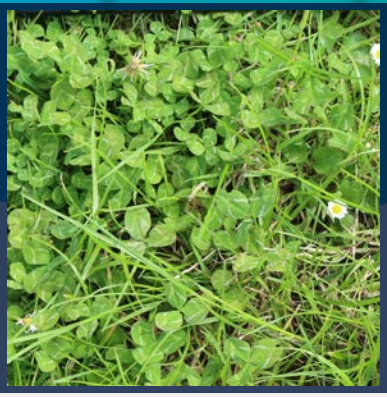
Biomass prediction



Deep regression

Dry herbage mass
650.4 kg DM/ha

Dry biomass percentage
75.65% grass
18.83% clover
5.52% weeds

Grass height
8.2 cm

INTRODUCTION

Deep learning models are performant but require l**arge amounts of labeled training data**

Harvesting and ground-truthing herbage samples is time consuming because elements have to be **separated by hand**

Can **unlabeled images** be used to improve the performance of a deep learning model for herbage biomass prediction ?

MATERIALS AND METHODS

Dataset presentation:

Harvested in July 2020 at the Moorepark Teagasc grass research centre near Cork, Ireland

Ground-truthed		Unlabeled
50 images training	100 images validation	592 images

Unsupervised learning:

Train a neural network to learn representation from raw data alone. We use contrastive learning **[1]**.

RESULTS

Because the neural network learned relevant initial features on the unlabeled images, we reduce the final biomass estimation errors.

Table 1: RMSE errors on a held out validation set

	Herbage mass (kg DM/ha)	Herbage height (cm)	Grass (%)	Clover (%)	Weeds (%)	Composition avg. (%)
Baseline	332.02	1.94	12.71	10.28	3.97	8.98
Unsup pretrain	**245.97**	**1.48**	**5.54**	**4.92**	**2.85**	**4.44**

CONCLUSION

Unlabeled images were used to reduce the error of the deep regression model

Possible applications on phone devices to help farmers predict herbage composition precisely. This is a hard visual task for humans.

Guide decisions for targeted nitrogen fertilization and improve feed palatability and milk production

[1] Lee, Kibok, et al. "i-mix: A domain-agnostic strategy for contrastive representation learning." *ICLR* (2020).

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