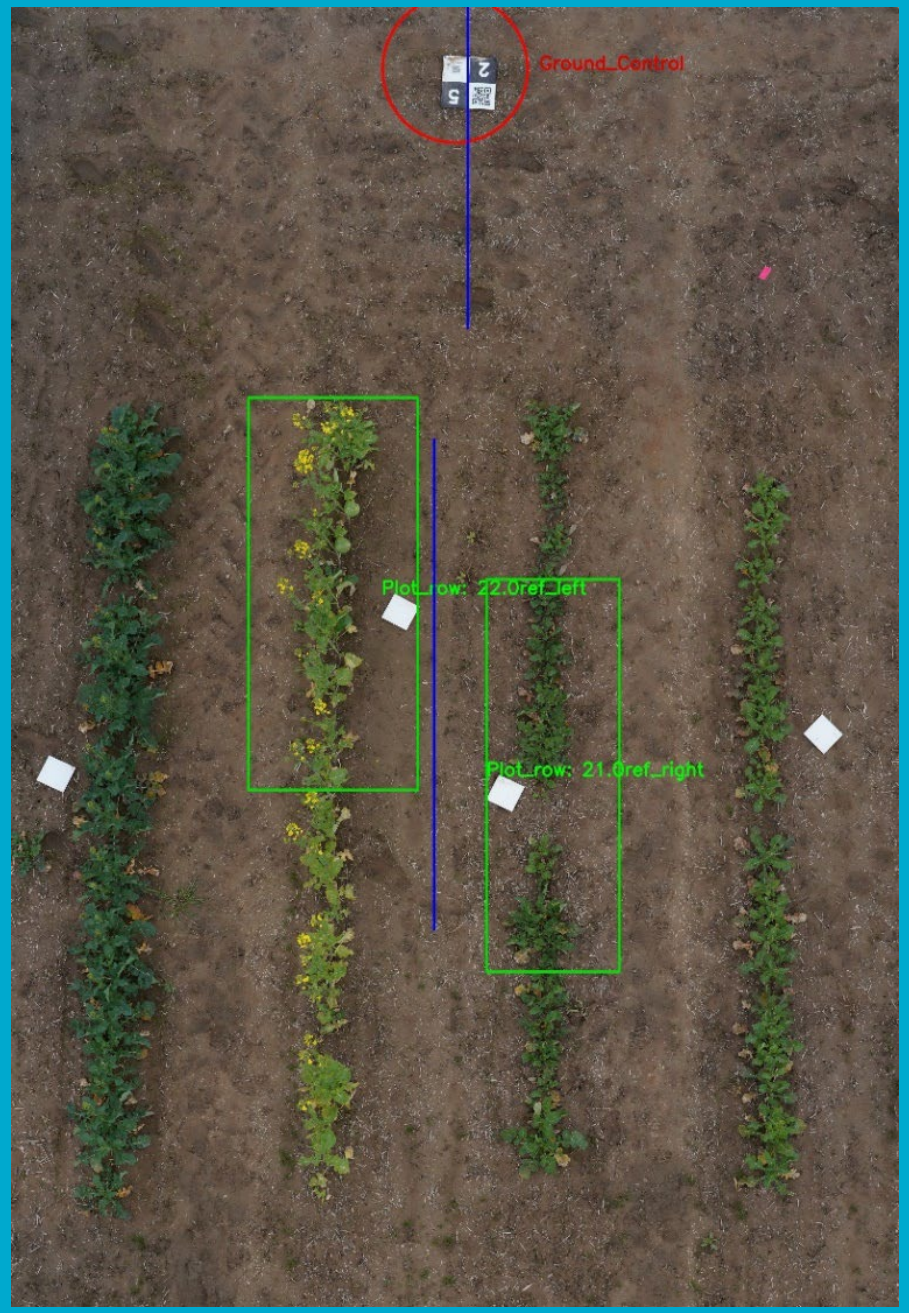
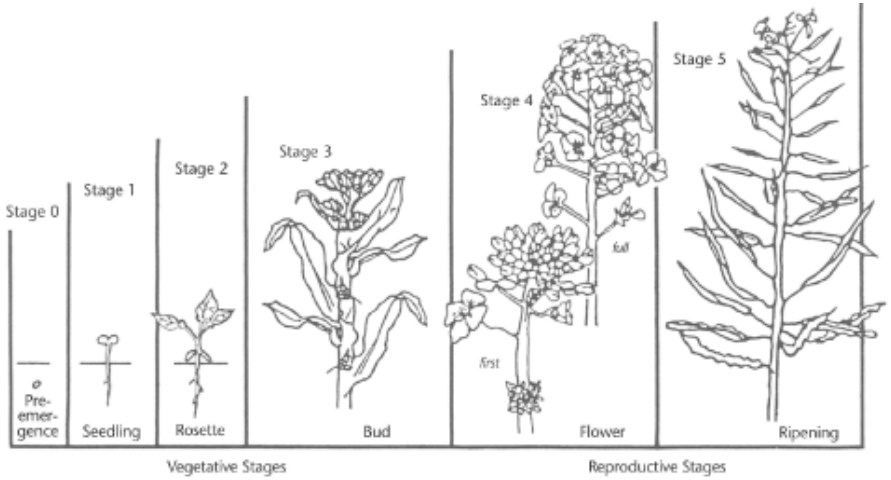
UAV imaging and deep learning for automatic canola phenology detection



Knowledge of phenology is vital to optimise canola productivity

- Targeting the optimal flowering window maximises yield
- Requires knowledge of variety phenology across growing areas
- Phenology scoring: costly, time consuming and labour intensive



Can we use modern technology to make phenology scoring faster, easier and cheaper?

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Workflow detail

Image Collection → Image and data Analysis → Automatic Phenology score

accessible tech

- Organ/plant level
- Plot level

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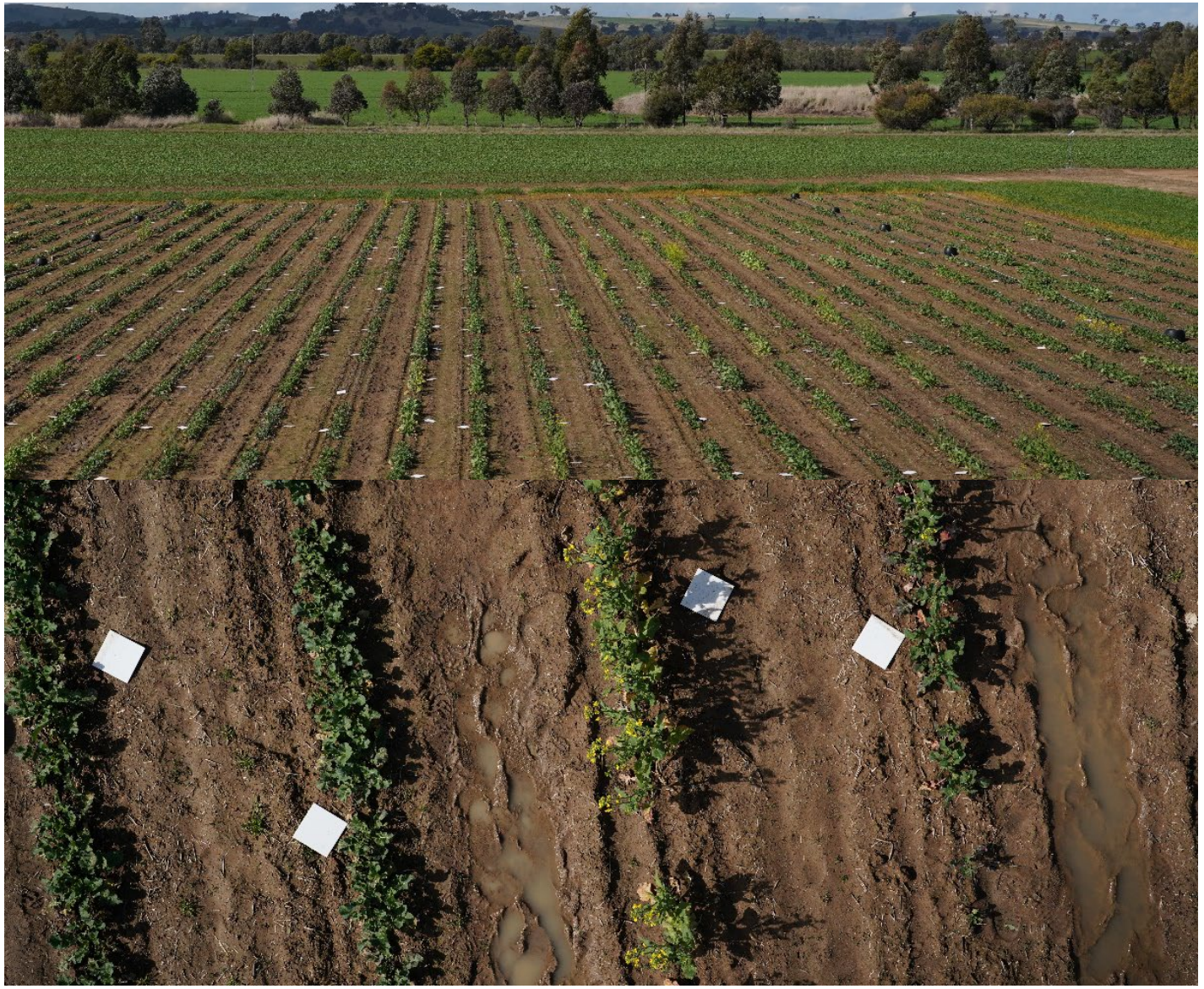
Data collection

- 70,000 field observations
- 6 months
- 90,000 drone images



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Plant/organ detection model

Growth stage Annotations

From 1st leaf to flowering stage

19231 labelled bounding boxes.

Machine learning model

Faster RCN Resnet-50

Canola field Images

Detection

- Location
- Precision score
- Growth stage

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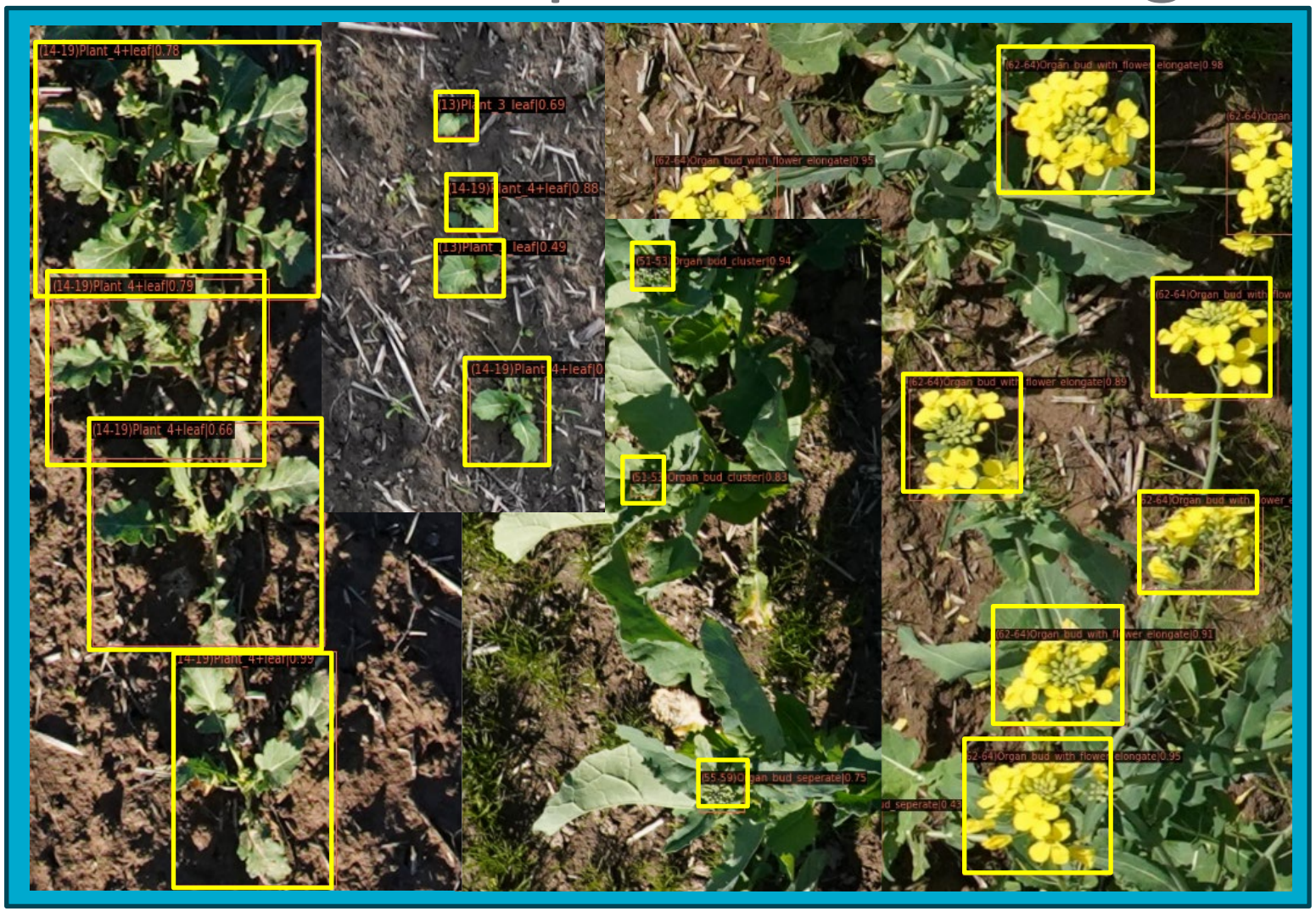
Simple detection experiments on agriculture image



Mean Average Precision

0.603

Field detection?

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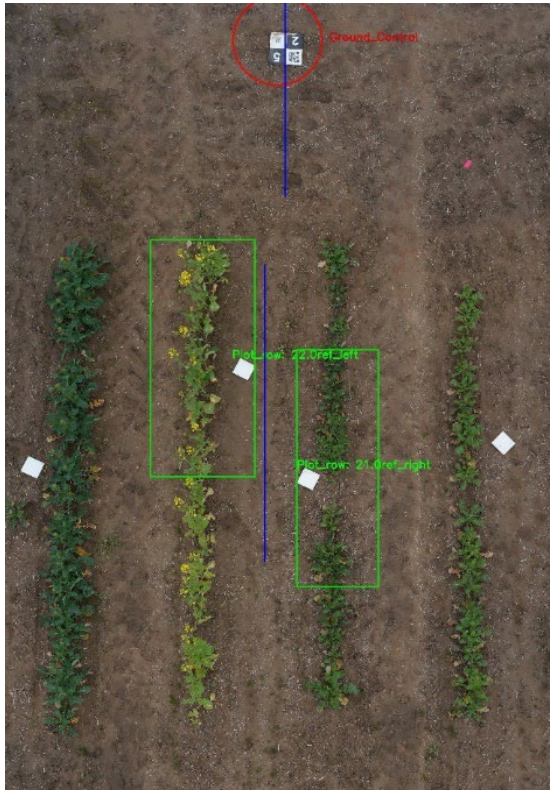
Plot image segmentation



5456 pictures covering the canola late growth stage

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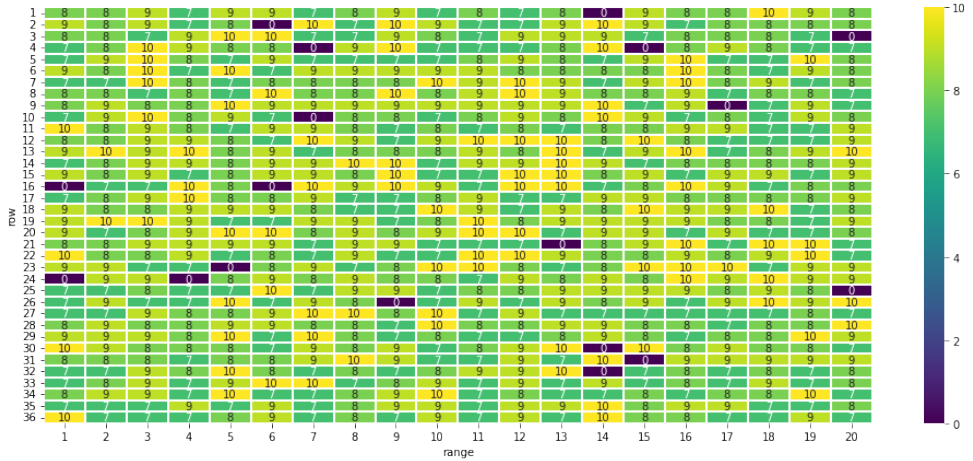
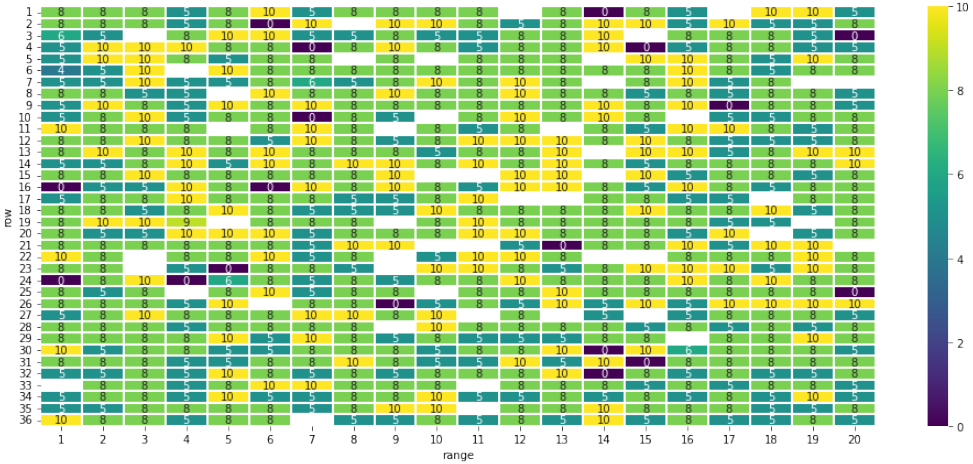
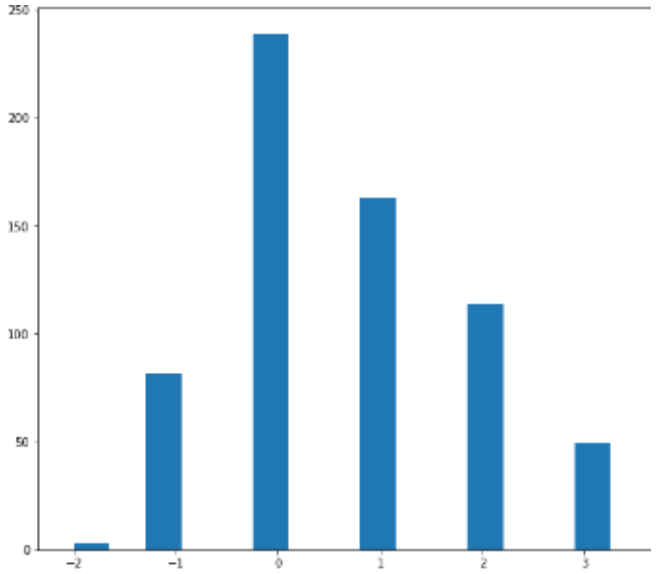
How effective is the model?



Field observation



Inference



Pearson correlation coefficient
0.7763.

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Plot level classification model

Field plot Images

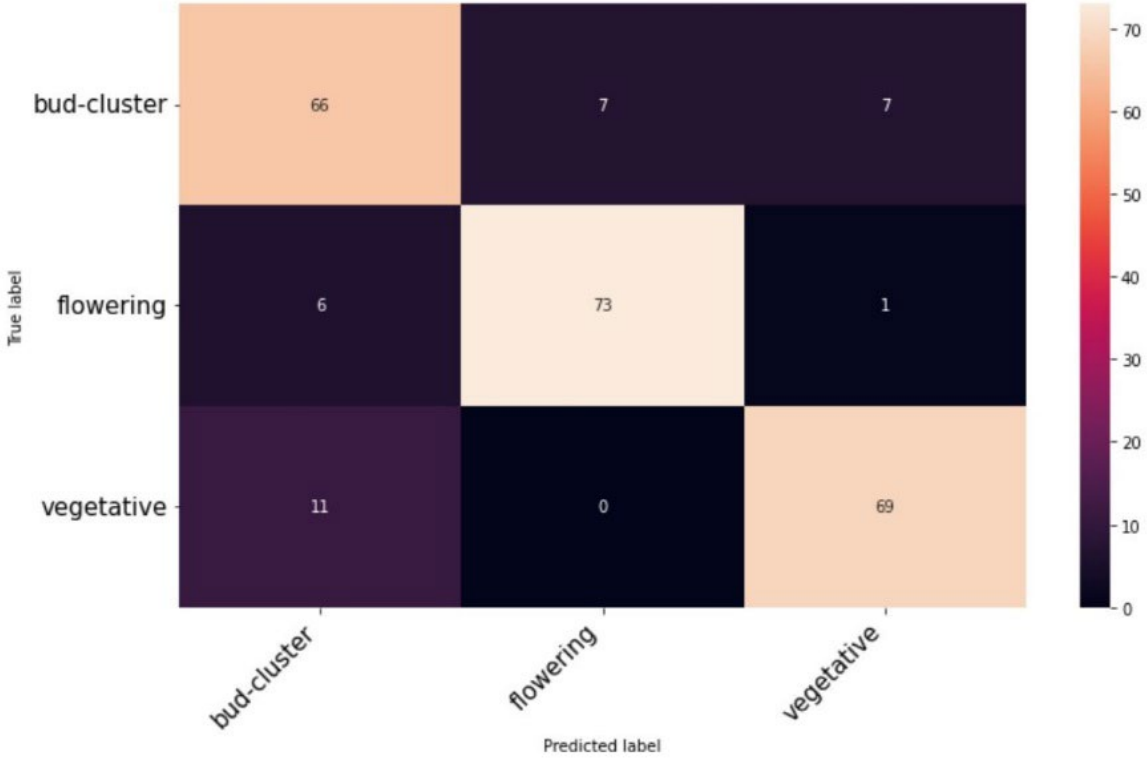
Field observations

B	C	D	E	F
row	range	shortID	sampling_date	score
1	1	S4EBABB549000001	1/10/2021	0
1	2	S4EBABB549240001	1/10/2021	60
1	3	S4EBABB549480001	1/10/2021	60
1	8	S4EBABB549FC0001	1/10/2021	60
1	9	S4EBABB54A200001	1/10/2021	60
1	10	S4EBABB54A440001	1/10/2021	57
1	11	S4EBABB54A680001	1/10/2021	60

scikit learn PyTorch

Machine learning model

plot classification



Best validation Accuracy 0.866667

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Conclusion

- 2 models : Organ/plant and plot level

- Application in research and commercial settings
- Faster, easier and cheaper than manual scoring.
- Powerful new tool for plant breeding programmes

- Add early stage to the classification model

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Thank you

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