Developing a sugar beet counting framework based on deep learning algorithms

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# ABSTRACT

The following paper provides insight into the idea of detecting sugar beet plants in photos. The basis of our research is that for a sugar beet farm, it is necessary to count how many plants are present in one's own field to plan potential replanting and calculate the projected earnings from said field. The conventional method of these counts is simple but time-consuming. In this approach, a certain percentage of the cultivated field is chosen, and the number of healthy plants in the two-leaf stage is simply counted. This number is then extrapolated to the entire field.

To improve this time-consuming counting process, we have developed the approach under investigation here, utilizing drones or smartphone images. Under the right conditions, this method aims not only to count a small portion of the plants in an entire field but all the plants in the field. This allows for a much more accurate determination of the number of plants in the two-leaf stage compared to interpolating the conventional method. Furthermore, the method we developed could enable very precise dosing and thus a more economical use of pesticides.

To recognize the plants in the drone or smartphone images, we use a self-trained YOLOv6 model, which is intended to produce the required results.

## Keywords

Deep learning, YOLOv6, crop science, photogrammetry, sugar beet, single plant counting.

# INTRODUCTION

# MATERIALS AND METHODS

Resolution testing:

To expedite computational time, streamline processing steps, and enhance overall efficiency, we endeavored to reduce the original image resolution of 4000x3000 pixels. Consequently, we resampled the images to explore whether employing lower resolutions significantly impacted the model's accuracy. Ultimately, we opted for the intermediate resolution among those examined, as it appeared to strike the best compromise between accuracy and processing speed. The final resolution chosen was 2000x1500 pixels per image. To achieve this resolution, we utilized the "resize" function from the cv2 package.

Another resolution tested, depicted in the figure (??????), was 1000x750 pixels. However, this resolution proved to be a substantial degradation of image quality, as evident in the figure (??????). Notably, the edges of the sugar beet leaves are no longer distinctly delineated, and this observation was further substantiated by a decline in model training performance.

Ein Bild, das Gelände, Boden, Pythium, draußen enthält.

Automatisch generierte Beschreibung

4000x3000 Pixel

2000x1500 Pixel

1000x750 Pixel

Figure 1 Different resolutions for testing

## Study area

## Data

## Method

Create workflow figure.

Comparison of different image resolutions for model training (same settings).

# RESULTS

Present notebooks and program.

Show some images of detected plants.

Present performance measures.

Show model results on orthophoto and counting result.

# DISCUSSION

No possibility to check on other data (e.g. drone data, different weather conditions or regions). Overfitting?

Limitation of the model to decide between sugar beet and no sugar beet, weeds might cause trouble.

Pretty basic model and approach but already usable in practice.

# CONCLUSION

# REFERENCES

# APPENDIX