Rapid biotest for fertilizer's effects

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Introduction

In precision agriculture there are several methods to describe an agricultural area, for example, yield mapping, remote sensing and local soil and plant analysis. Besides that, differences in the plant size are caused by several effects, therefore it is not easy to choose the right treating method. Generally applied fertilisers and organic fertilisers could improve yield and the organic matter content of soil, optimize the soil water management etc. To select the appropriate methods rapid biotesting is the simplest method to take advice for us.

Small pot experiment is a widespread method to estimate the soil treatment effects. After Chaminade works there were several experiments achieved, which involved the plants' germination ability, growing data, height (length), root length etc (Chaminade 1960, Poorter et al., 2012, Szabó et al., 2012).

Effects of the treatments and these possible relations are established when the pot experiment is combined with the orthogonal factor model (Biczók et al., 1994).

Materials and methods

Our aim was to determine the NPK fertiliser effects on an assigned agricultural area with the rapid pot experiment. This method contains a 2m diameter ring, which turns around approximately 3 times per hour. On this ring there are 32 pots, which contain the treated soil and plants seeds. All the treated soil sets to 60% of water holding capacity. Above this ring there are plants' growing lamps and a camera system, which takes pictures of every pot in every circle and controls the irrigation system. After 1-2 weeks of growing season, we collect the images and analyze them with an internally developed software. This program is counting the number of green pixels on the images. Base on this pixel values we could determine the growing curve. After the software calculates the growing data, we analyze the differences between the growing effect of the plants with a nonlinear function fitting, which does not have larger error than 0.5 %.

On the other hand, to optimize the treated factors we apply the orthogonal factor model, which has 2 different levels with N, P and K fertiliser and one center of the factor model, which contains 50% concentration all of the fertilisers. These treatments are shown in table 1 which is the data calculated from kg/ha.

Table 1: Calculated soil treatments with NPK fertiliser g/kg

	1	2	3	4	5	6	7	8	9	10
NH_4NO_3	332,4	0	332,4	0	332,4	0	332,4	0	332,4	332,4
H_3PO_4	156	156	0	0	156	156	0	0	78	78
KCl	179	179	179	179	0	0	0	0	89,5	89,5

After running the model we calculated the orthogonal factors and estimate the effects of the different soils and fertilisers.

Results and discussion

In each of the pots we calculate the green mass change over the time. Figure 1. presents the different soil and treatments with a sigmoid function.: $y = \frac{A}{1+e^{b*(x-x0)}}$

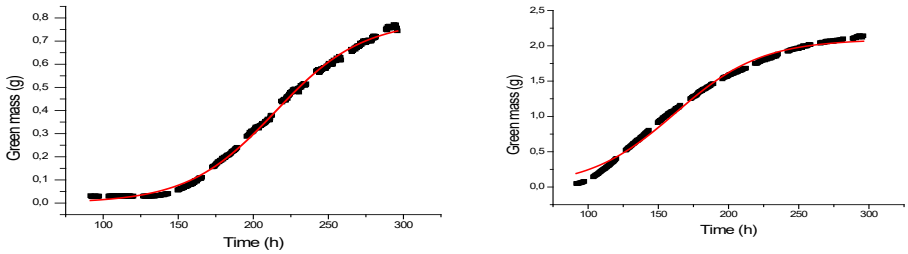

Figure 1: The maximum of the green mass with sigmoid function.

On the factor model we calculate the following equation (p<10%):

$$A = 17706{,}8 + 6{,}34 * N + 6{,}69 * P + 1{,}4 * K - 0{,}43 * N * P - 0{,}05 * N * K + 0{,}03 * P * K + 0{,}003 * N * P * K$$

Conclusions

In the rapid pot experiment, we could estimate the small differences of the treatments. The fertilised sample area has not significant differences. Besides N supply with the maximal K and P doses is not significantly larger but our treatments have negative effect to the seeds germination and plans growing. Furthermore, P and K fertilisers have not significantly effects, but the medium specialties of the area represent in this result. These results prove that the rapid biotest is appropriate for describe the different soil treatments effects.

References

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