Inoculating field soils after potato harvest with donor soils from established grass-clover fields decreases the yields of subsequent grass-clover crops

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Abstract

Inoculating field soils with donor soil can potentially increase crop productivity through improved nutrient uptake and faster establishment of the crop. Soil inoculation with specific biota taxa or donor soils has already been found promising in restoration of grass lands or natural reserves. Applying this method in agriculture can potentially reduce fertiliser, herbicides or pesticide usage while increasing yields. The hypothesis was tested whether inoculation of field soils with donor soils from established grass-clover fields increases the productivity of subsequently sown grass-clover through the addition of beneficial soil biota. A full factorial split-split-pot experiment was designed, where a mix of grass (*Lolium multiflorum*) and clover (*Trifolium pratense*) was grown in field soils collected after potato harvest. Recipient soils were collected from fields under conventional and organic management. Donor soil (inoculum) was collected from 12 locations in a two-year-old grass-clover field under organic management, as it was expected to have a higher density and diversity of soil biota than a field under conventional management. Four types of donor soils were used: donor soils with low genetic diversity, high genetic diversity, sterilised soil from grass-clover with low genetic diversity and potato soil from the same location as the recipient soil. Inoculating potato soils with donor soils reduced grass-clover productivity. The effect of inoculation was significant for all donor soils and both organic and conventional management. No clear effect in strength of response could be linked to either management practice. Results were negative from an agronomical perspective, but proved that the addition of field soil as inoculum can be used to alter crop productivity. Spatial heterogeneity of recipient soils resulted in strong yield variations and need to be accounted for in future research. Strong indication is provided that inoculation of field soils with donor soil can be a measure to shift crop productivity. Application in other cropping systems with potentially positive effects should be explored.

<u>Keywords:</u> Plant-soil (belowground) interactions, soil inoculation, field soil, soil biota, soil biodiversity, grass-clover, potato

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1. Introduction

Soil biota and their diversity potentially play a key role in crop productivity and the recycling and retention of nutrients (Wagg et al. 2014; Bender et al. 2015). However, current intensive agricultural practices negatively affect the presence, composition and abundance of soil biota (Postma-Blaauw et al. 2010; Tsiafouli et al, 2015). It has become increasingly evident that intensive agriculture decreases the diversity of soil biota and can have a strong, negative effect on the structure and composition of soil food webs (Postma-Blaauw et al. 2010; de Vries et al. 2013). In intensive cropping systems, where tillage, pesticides and chemical fertilisers are commonly used, soil food webs have been shown to be less complex than those in undisturbed grasslands (Verbruggen et al. 2010; de Vries et al, 2013; Tsiafouli, et al. 2015). A reduction of soil biota diversity can cause a reduction in decomposition and recycling of nitrogen (Wardle, et al, 2013). Additionally, limited soil biota diversity causes a large fraction of Nitrogen inputs to remain unused or lost through leaching and gas emissions (Liu et al, 2010). Besides the effects on nitrogen, a decrease in soil biota diversity was observed to increase phosphorus losses after rainfalls (Wagg et al, 2014). The composition and diversity of the soil biotic community could thus have an important impact on crop productivity.

Plant-soil interaction

The chemical, physical and biological characteristics of the soil play a key role in determining productivity of plants. However, these characteristics can also be influenced by plants (van der Putten et al. 2013; Kos et al. 2015). The process of plants modifying the biotic or abiotic characteristics of their soil environment is called direct plant soil feedback (PSF) (van der Putten et al. 2013). Through this process, plants condition the soil they grow in and e.g. increase nutrient availability or the presence of pathogens or mycorrhiza (Kos et al. 2015a). Soil biota contribute to succession and plant species diversity through the inhibition or stimulation of specific plant species (De Deyn et al. 2003; De Deyn & Van der Putten, 2005; Kardol et al. 2006), indicating that above- and belowground diversity are strongly related. The response in plant performance to soil conditioning can be positive or negative, depending on the plant species that conditioned the soil as well as the plant species that respond to soil conditioning (Bever 2003; Van der Putten et al. 2013). Furthermore, the impact of belowground biota composition on aboveground composition depends on soil fertility and biotic soil conditions (De Deyn et al. 2004; Kos et al. 2015).

The majority of studies analysing effects of PSF focussed on spatially homogeneous soils. However, spatial heterogeneity has been identified as a driver for plant community composition, although most studies focussed on abiotic soil characteristics (Lundholm 2009; Reynolds and Haubensak 2009; Tamme et al. 2010; Allouche et al. 2012). Further, plant to plant spatial heterogeneity is likely to be driven by biotic interactions (Bezemer et al. 2010).

Soil biota and PSF can strongly affect the establishment, diversity and successional replacement of plant species as well as plant performance (Bever, 2003; De Deyn et al. 2003, Kardol et al. 2006; Middleton & Bever, 2012; Van der Putten, et al. 2013). Depending on root-associated rhizodeposits excreted by the plant, the response of soil biota communities changes among plants (Raaijmakers et al. 2009; Bever et al. 2012; Philippot et al. 2013). Furthermore, temporal variations in the history of the soil can have a profound effect on the assemblage and development of an ecosystem and thus above- and belowground communities (Kardol et al. 2013). Recent findings in ecological experiments additionally indicate, that PSF effects exceed the plant-soil level. When growing plant associations in conditioned soils, PSF led to species-specific effects on plant-insect interactions, indicating potential effects of PSF on pest suppression (Kos et al. 2015).

The interrelation of plants, the soil and environmental variations throughout time thus shapes the composition of an ecosystem. As the composition of soil biota communities is dynamic and tends to evolve along succession gradients of aboveground community composition (Middleton & Bever, 2012), succession of soil life throughout time is an aspect that needs further exploration.

Effects of agricultural management on soil biota

Soil life has been found to adapt or specialise to specific, local inputs like plant litter or other organic materials over time. Historical factors, such as mineral fertiliser application or organic matter amendments, can therefore shape soil biota communities and thus influence decomposition and mineralisation (Rashid et al. 2012). In general, composition of soil decomposer communities and their interaction with specific characteristics of organic matter, in combination with local abiotic soil characteristics is estimated to cause 30% of the observed, global variation in decomposition of organic matter (Ayres et al. 2009). However, these factors and the strength of the interactions between them vary among ecosystems and biomass additions (Wall et al. 2008). Exposure of soil biota to local biomass input typically leads to specialisation of soil biota and an increase in decomposition rates. This concept is called home field advantage and has first been studied in forest ecosystems. Recently, experiments were carried out to determine comparable effects in production grasslands, to which solid cattle manure was applied. Fertilisation history and the type of manure added to a field proved to have a strong effect on dry matter disappearance. The disappearance of manure dry matter and nitrogen was 20 and 14% greater on home fields, where soil biota had adapted to added manure for several years, compared to manure applied on away fields, where soil biota were adapted to other compositions of manure (Rashid et al. 2013). Site-specific management thus affects plant-soil interactions and regulation of available nitrogen. Although home field advantage is mainly concerned with decomposers, comparable beneficial effects can be linked to overall presence of soil biota (Wardle, 2013). Comparing conventional and organic management, higher overall abundance of soil biota was found in soils under organic management, as conditions for specific taxa are more favourable in organic fields (Gosling et al. 2006, Li et al. 2012; Henneron et al. 2015). Further, application of mineral fertilisers and herbicides can negatively affect natural control of aboveground pests by benefitting aphid populations and reduced PSF effects on herbivory (Birkhofer et al. 2008; Kos et al. 2015). This provides strong evidence that soil biota specialisation can be induced through management practices as well as naturally occurring PSF.

Soil transplantation and inoculation

In recent studies in ecology and nature restoration, soil transplantation has been used to translocate top soils. In this process, the introduction of new soil biota and seed banks via soil translocation offsets pressure on existing soil biota and propagates native vegetation (Ferreira et al. 2015). However, this measure can be highly detrimental for vegetation and biodiversity of the donor environment, as a large fraction of the topsoil is stripped and taken out. Evolving from these practices, soil inoculation has been studied, ranging from the addition of: (1) specific soil biota (Heijden et al. 2006; Köhl et al. 2016), (2) compositions of soil biota (Bender et al. 2015), to (3) the addition of established soil biota networks from established ecosystems (Carbajo et al. 2011). In contrast to the use of specific taxa, inoculating soils with a whole, diverse soil biota community is a more effective stimulation of plant growth (Hoeksema et al. 2010). Depending on the recipient spoil type, establishment of introduced soil biota through inoculation can be difficult given high abundance of residing soil biota (Carbajo et al. 2011). To be able to sustain inoculation in an agricultural context, methods must be adapted so that they are in line with common agricultural practices and can be implemented in a rotation.

Potential of inoculation in (organic) agriculture

The influence of soil biota and PSF on crop productivity and nutrient availability are especially important in organic agriculture, where farmers aim to maintain soil fertility through a balanced soil organic matter content and implementation of cover crops (Wagg et al. 2014; Bender et al. 2015). A range of studies has analysed potential methods to increase soil fertility by management practices less harmful to soil life, such as crop rotation, reduced tillage or mulching (Wardle, 1995;

Giller et al. 1997). Next to their impact on soil fertility, these practices also reduce stress posed on soil biota.
The current study examined whether inoculation of field soils with donor soils can increase crop establishment and productivity. The crop conditioning the recipient soil was potato. Soils of potato fields show lower richness of arbuscular mycorrhizal fungi (AMF) species than natural grassland vegetation (Verbruggen et al. 2010). Producing potatoes deteriorates soil biota, reduces soil aggregates and existing AMF networks through intensive tillage and harvest techniques (Postma-Blaauw et al. 2010; de Vries et al. 2015; Tsiafouli et at., 2015). As AMF networks are especially important for plant nutrient uptake, restoring these networks or soil biotic communities typically increases plant productivity. In a crop rotation, rest- or mow-crops can be introduced to reduce pressure on soil biota and to restore soil health after potato harvest. Additionally, inoculating soils with AMF can significantly change recipient soils and increase attained yields (Bender et al. 2015). However, with this method only a small subset of the soil biota relevant and beneficial for the crop are introduced and effects are often only significant during short periods after inoculation. Increasing the complexity of the donor soil by transplanting fractions of a fully established and adapted soil biota community of a target crop, observed beneficial effects on that crop (Hoeksema et al. 2010), such as increased nutrient use efficiency, reduced leaching or higher yields, may increase. As the results of Sun et al. (2014) and Bender et al. (2015) indicated, these effects might be limited in time due to succession and adaptation of soil biota to local conditions of recipient soil. However, as rotations in agriculture in Western Europe are mostly practised with a scope of 1 year, such short-term benefits would be sufficient.

2. Hypotheses

Prior to this experiment, soil inoculation with specific soil biota taxa or donor soils had been explored. Results from nature restoration and other ecological studies provided promising results of the beneficial effects of soil inoculation on plant establishment, nutrient uptake, plant community composition as well as response to weed or pest pressure. However, application in an agricultural context had not yet been explored.
Here it was experimentally tested whether inoculation of soil can be a tool to improve crop productivity in a crop rotation system, when potentially beneficial soil biota communities are introduced in small proportions. Recipient soils were collected from fields under organic and conventional management, to determine whether the effect of soil inoculation is affected by e.g. the use of pesticides. It was assumed that high aboveground biodiversity directly relates to high belowground biodiversity. If donor soils were collected from fields with a high genetic diverse crop, it was thus expected that soil biota would be more diverse than biota contained in a donor soil collected from low genetic diverse crops. Due to favourable management, it was further assumed that organic soils have a larger range of soil life and that the soil food web was more elaborate than in soils under conventional management.
The main research question was whether inoculation of potato soil with donor soil collected from grass-clover fields can be used to increase productivity and efficiency in nutrient uptake of grass-clover sown in potato soils. It is hypothesised that soil inoculation will significantly alter plant productivity. Further, it is hypothesised that the inoculation of potato soils with donor soil from established grass-clover fields leads to more stable effects than inoculation with specific soil biota taxa, as a fraction of a whole community is introduced.

The potential effects of inoculating potato soils with different compositions of soil biota from clover fields were analysed with regard to: (1) aboveground biomass production, (2) root biomass production and (3) nutrient uptake.

The following specific hypotheses were tested: (1) If soil transplantation improves soil life in former potato fields, grass-clover on inoculated soils attains higher yields than grass-clover grown on non-inoculated soils; (2) If more aboveground diversity increases soil biota diversity, the soils inoculated with a donor soil conditioned by a high genetic diversity mixture of grasses and clovers perform better than those inoculated with soil conditioned by simple mixture of grass-clover; (3) If conventional management is more detrimental for soil life, inoculation of recipient soils from conventional potato fields shows larger effects than inoculation of recipient soils from organic potato fields.

3. Materials and Methods

To analyse the effects of soil inoculation on crop productivity a full factorial split-split pot experiment was set up in the greenhouses of Wageningen UR. Field soils from two management systems (organic and conventional) were inoculated with donor soils collected from organic grass-clover fields. The experiment consisted in total of 168 pots, which were divided in 3 blocks of 56 pots (see table 1).

Soil origin and characteristics

The recipient soils of this research were collected at two different locations, which were approximately 1250m apart. The soil from organic potato fields was collected at Droevendaal Farm, Wageningen, the Netherlands (51°59'27.3"N, 5°39'46.7"E), where a 6-year rotation is practised as part of a strip cropping experiment. All crops of this experiment are grown in strips of 240m length and 3m width, divided in 12 plots of 20m (see appendix 1). The experiment covers a mixture of 3 potato varieties as well as a monoculture, which are grown in separate plots of one strip. For this experiment the 6 plots with monocultures (1 variety) were chosen, as they best represented common agricultural practise. Per plot, six random soil samples of 20 litres were taken (see appendix 2 for locations), which were subsequently combined into one composite sample per plot. Heterogeneity within each plot was thereby averaged but spatial variability (between plots) was kept, allowing to explore possible site-specific effects along field gradients. The recipient soils were taken from a depth of 0 to 20cm, as this layer is most affected by crop management. The 6 recipient soils under conventional management were collected from a field of Unifarm, also part of Wageningen UR (51°59'24.8"N, 5°38'46.8"E). The field size for soil collection was adapted to the sampling scheme used in the organic field and all recipient soils were thus collected following the same pattern. A total of six organic and six conventional recipient soils were collected. All soils were sieved (mesh size = 0.3cm), to exclude effects of crop residues or larger soil fauna.

The donor soils were collected in strip one of the previously introduced rotation experiment at the end of the growing season (September, October 2015). As with recipient soils, donor soils were collected at 6 random locations in each plot and subsequently combined in one inoculum per plot (see appendix 2).

Soil abiotic characteristics were measured for N-NH_4, N-NO_3, P-PO_4 (CaCl2 extraction, auto analyser), K and Mg (CaCl2 extraction, Varian), soil organic matter content (dried at 103°C for 8 hours and ashed at 550°C for 3 hours) as well as soil acidity (1:2.5, water suspension; see tables in appendix 3, 4 and 5). Based on these results, available nutrients were calculated per soil volume of each pot and added donor soil. Total nitrogen was calculated as the sum of nitrogen contained in NO3 and NH4.

Table 1 – Overview of recipient and donor soil combinations of the experiment. Recipient field soils were collected at 12 different locations over two types of management (see appendix 2). Abbreviations for donor soil: "CNM" grass-clover no-mix, "CM" grass-clover mix, "SC" sterile grass-clover, "PO" potato organic, "PC" potato conventional, "CO" clover, no-mix old, which was taken from late succession grassland.

Recipient soil	Donor soil (inoculum)	Samples total
Organic potato soil	Clover no-mix (CNM)	18
Organic potato soil	Clover mix (CM)	18
Organic potato soil	Sterile clover no-mix (SC)	18
Organic potato soil	Organic potato soil (PO)	18
Conventional potato soil	Clover no-mix (CNM)	18
Conventional potato soil	Clover mix (CM)	18
Conventional potato soil	Sterile clover no-mix (CS)	18
Conventional potato soil	Conventional potato soil (PC)	18
Organic potato soil	Clover no-mix, old (CO)	12
Organic clover no-mix	Organic clover no-mix	12

* samples not part of main experiment.

Experimental design

The experiment was carried out in the greenhouses of Wageningen UR and was set up as a multi factorial split-split-plot experiment with three blocks. It consisted of two factors: 'management' (twelve field soils of which six under conventional and six under organic management) and 'inoculation' (addition of donor soil). The recipient soils of the main experiment were inoculated with one of four different donor soils: (1) a low genetic diversity grass-clover (no-mix; CNM), (2) high genetic diversity grass-clover (mix; CM), (3) sterilised grass-clover soil from the no-mix (CS) and (4) an addition of donor soil from the same field location as recipient soil (PO, PC).

The required sample size was calculated using the R-statistical software (3.3.0) (R Core Team 2016). Sample size "n" was calculated based on significance level=0.05, effect size (d)=0.5 (standard deviations) and power=0.8 for a two-sample t-test (R Core Team, 2016). The minimal sample size was calculated as 64 and given the 12 available plots as source of donor soil, a multitude of 12 above this value was chosen. This yielded a sample size of n=72 with a minimal detection limit of effect size 0.47 standard deviations.

In the current experiment, 72 pots were filled with potato soil from the 12 available locations and inoculated with either donor soil collected from high or low genetically diverse grass-clover (treatment group). As a control group, the same number of pots was inoculated with either sterilised grass-clover soil from the low genetic diversity plots (autoclaved) or an addition of recipient soil from the same location (see appendix 6). Recipient soils of treatment and control group were collected at the same locations. Spatial variation was accounted for by matching samples according to their original field location. Recipient soils from the first plot were thus inoculated with donor soils from the first plot of the grass-clover field (see Appendix 1 and 2). Together with two smaller experiments (see paragraph additional experiments), the current experiment consisted of 168 pots (see appendix 6).

Soil inoculation

Cylindrical pots (d=19,5cm; 0.03m^2) were filled with recipient soils (3.5L) and were hung in larger cachepots (Mitscherlich pots). This prevented water logging in the pots and allowed to measure potential leaching. Meshes were placed in the pots, to prevent soil being flushed out during watering. The pots were numbered to allow for double-blind observations and therewith prevented unintentional bias. The amount of donor soil applied was set out to be in line with common agricultural practices of e.g. manure application. Donor soils were therefore added in proportions of 2.14% (75ml in total) to each pot, corresponding to 25t/ha. The donor soil was spread evenly on top of recipient soil in each pot and then incorporated in the top layer (2cm). Potential effects of drought on the contained soil life, which can have a considerable effect on the biota in a thin top layer of donor soil, were thereby reduced.

Plants and seeding

A mixture of red clover (*Trifolium pratense cv. Lucrum*) and Italian ryegrass (*Lolium multiflorum cv. Sultano*) seeds was sown. Seeds were counted to ensure that the number of plants per pot was even. A seeding density of 1> seed density >1.5 plants per $10cm^2$ was chosen, corresponding with 5kg/ha of red clover and 35kg/ha Italian ryegrass, both common seeding rates in arable systems. The fine clover seeds were mixed with fine, dry quartz sand to ensure an even distribution and full cover.

After 12 weeks of growth, aboveground biomass of grass and clover were collected separately, dried at 70°C to constant weight and separate dry weights were determined. Roots were extracted from the soil by carefully washing them over a sieve (2-mm mesh) and subsequently dried and weighted. Root biomass was sampled per pot.

Greenhouse conditions

To limit effects of placement in the greenhouse, e.g. edge effects, the setup was randomised in location and time, using a Latin hyper cube design. Next to randomised locations in the greenhouse, stable growing conditions were established, which mirrored average weather conditions of Wageningen, the Netherlands, in August 2015. Maximal temperature per day was limited to 22°C (measured 24°C) to reduce possible heat stress on the crop.

Balanced water content

All pots were set to 60% water holding capacity (WHC) at the start of the experiment, whereas the desired water content of the soils was build up gradually to prevent the fine sieved soils from collapsing. Water was applied 3 to 4 times a week using a fine spray nozzle with low water pressure. This method facilitated an even distribution of water across the diameter of the pots and mirrored field conditions during rainfalls. To exclude reduced water availability as confining factor, pot weights were measured with a balance once every 2 weeks and water was added to re-establish 60% WHC. Additionally, a leaching experiment was included in the overall setup to determine possible effects of inoculation on nutrient losses. After 7 and 9 weeks of growth, strong, incidental rainfalls were simulated by adding 1.5 litres of water to each pot. Excess water was measured after 2 days and small subsamples were taken for nutrient analysis.

Plant nutrient uptake

The dried aboveground biomass was combined per pot and milled at 1mm to determine NPK uptake of the crop. Samples were then digested with a mixture of H_2SO_4-Se and salicylic acid (Novozamski et al. 1983). In the attained digests total N and P were measured spectrophotometrically with a segmented flow system (Auto-analyser II, Technicon). In the same digests, potassium was measured with a Varian AA240FS fast sequential atomic absorption spectrometer. Due to financial restrictions, this analysis was only carried out for pots of block 2 of the experiment as these could showed a linear relation to results of other blocks (see appendix 10).

Additional experiments

Next to the main experiment, two small experiments were included in the overall setup (12 pots each). The first was set out to analyse the effect of seeding grass-clover on soils conditioned by the same crop for 2 years. From each plot used as source of the donor soils, a composite soil sample of 15 litres was taken as recipient soil (see appendix 2). These soils were prepared in the same way as those of the main experiment and donor soil was added from matching field locations. The second experiment focussed on the effects of inoculating recipient soils with donor soil collected from late successional grasslands (>20 years). As soil biota is expected to evolve gradually along aboveground succession, an inoculum from such fields was expected to have a different, potentially stronger effect on the biomass productivity of grass-clover. Twelve pots were inoculated with donor soil collected in a late successional arable field. Potato soil under organic management was used as recipient soil. It was hypothesised that older arable fields have a more complex soil life, so soils inoculated with late succession grass-clover soils perform better than those inoculated with an early succession donor soil.

Analysis harvest data

The analysis of collected data was done using the R statistical software (R Core Team 2016). The effects of soil inoculation and management on overall biomass productivity, clover and grass biomass separately as well as root biomass were analysed using mixed-effect modelling with the function *lme* in the library *lme4* and *nlme* (Bates et al. 2015; Pinheiro et al. 2016). Management and inoculation were used as fixed effects with an interaction term to account for possible variation in crop response on conventional and organic soils. The effects of nutrient levels in recipient and donor soil were analysed following the protocol for model selection as introduced by Zuur et al. (2009). Results of the additional experiments were analysed separately, resulting in a total of 144 pots used as database for the following analysis.

The first model used to analyse collected data solely included factors of the experimental design: management, plot, block and inoculation. The effect of donor soil addition (Inoculation) was expected to be dependent on the management of recipient soil (organic vs. conventional management). Spatial variation or field location of recipient soil (Plot) was expected to influence the inoculation effects. As one sample from each plot with the same donor soil addition was placed in each block, the first model included "Plot" as a nested effect in "Block". The resulting model was:

Model 1: Biomass production = Management * Inoculation + (1|Block/Plot)

The same model was used to determine effects of inoculation and management on grass or clover yields separately as well as root biomass.

Possible effects of donor soil addition and contained soil biota on nutrient uptake of grass-clover were analysed by using the following model:

Model 2: Nutrient in crop (ppm) = Management * Inoculation + (1|Block/Plot)

Mixed effect models were applied to determine effects of soil organic matter (SOM), soil pH and available nutrients on shoot and root production. For total biomass, root biomass, clover biomass and grass biomass, significant factors were determined through model selection as introduced by Zuur et al. (2009, p. 130-142). In a first step, a full model was used, including an interaction term with inoculation to determine whether inoculation effects were dependent on specific soil characteristic.

M1Full: Biomass production = Inoculation*SOM (%) + Inoculation*Soil pH (-log(H_3O^+) + Inoculation*NO3 (mg/kg) + Inoculation*NH4 (mg/kg) + Inoculation*PO4 (mg/kg) + Inoculation*K (mg/kg) + Inoculation*Mg (mg/kg) + (random ~1 | Block)

Individual interactions were then excluded from the model, to determine whether they had a significant effect on biomass productivity based on their p-values (see Zuur et al. 2009, p. 134-136). Possible interactions were selected based on their significance at P=0.05. Those not significant were excluded in the following model:

M2Full: Biomass production = SOM(%) + Soil pH (-log(H_3O^+) + NO3 (mg/kg) + NH4 (mg/kg) + PO4 (mg/kg) + K (mg/kg) + Mg (mg/kg) + (random ~1 | Block)

Through the addition of donor soil, nutrients were added to each pot. The effects of nutrient addition were determined through model selection as introduced above. Significant effects were determined on their p-values, by excluding individual factors from the model. The full model used was:

M3Full: Biomass production = SOM + Soil pH (-log(H_3O^+) + NO3 (mg/kg) + NH4 (mg/kg) + PO4 (mg/kg) + K (mg/kg) + Mg (mg/kg) + NO3(donor soil) + NH4(donor soil) + PO4(donor soil) + K(donor soil) + Mg(donor soil) + (random ~1 | Block)

Prior to the analysis, all abiotic characteristics were calculated at total available level by taking into account soil weight of recipient and donor soils. In model selection, a random effect for "Block" was included.

Results from the additional experiments were calculated individually for each experiment. Leaching effects were analysed with the first introduced model (Model 1), changing biomass production for leached nutrients. The effect of late succession donor soil was calculated by adding these pots to the used data frame (144 pots of main experiment) and re-running the model with all 5 donor soils. Lastly, the effect of growing grass-clover on soils conditioned by the same crop for 2 years was analysed by adding these pots to the used data frame, using the same model as before (Model 1).

4. Results

Effect of soil inoculation on above- and belowground biomass production

Comparing inoculated soils of the treatment group (Mix + No-mix) to those of the control group (Sterile + Potato), a significant inoculation effect on aboveground productivity was found ($F_{1,106}$=9.09, P=0.003) (see appendix 7). Dry matter production of inoculated soils was 567.5g/m^2 on average. Soils of the control group produced an average yield of 584.9g/m^2 (see table 2 below for a more detailed overview).

Table 2 - Average yield per management and inoculation (donor soil). In brackets the min and max are stated.

	Donor soil			
Average yield (g/m2)	Clover Mix	Clover No-mix	Sterile clover No-mix	Potato
Organic potato soil	544.92 (423.58-757.75)	544.73 (423.58-723.93)	550.38 (423.58-785.88)	547.37 (423.58-726.27)
Conventional potato soil	603.89 (436.30-785.88)	604.41 (452.04-785.88)	605.46 (434.63-785.88)	608.65 (423.58-785.88)

The first model showed that the recipient soil had a significant effect on biomass productivity of grass-clover ($F_{1,32}$=40.16, P<0.001). Application of donor soil (inoculation) was found to be significant as well ($F_{3,102}$=3.03, P=0.033). No interaction effect was found between management and inoculation ($F_{3,102}$=1.30, P=0.278).

Management of recipient soil showed a significant effect on the formation of root biomass ($F_{1,32}$=16.90, P<0.001). None of the donor soil additions did show a significant effect ($F_{3,102}$=0.73, P=0.54) and there was no significant interaction effect between management and inoculation ($F_{3,102}$=0.56, P=0.64).
Analysing clover and grass individually, a significant effect of management was found for both clover ($F_{1,32}$=5.06, P=0.03) and grass ($F_{1,32}$=11.26, P=0.002). However, neither were significantly influenced by inoculation (clover: $F_{3,102}$=1.85, P=0.14 and grass: $F_{3,102}$=1.9214, P=0.13).

Soil origin of recipient soils strongly affected the yields of the crop and crop response varied along field locations (see figure 1). Highest yields were attained on soils with highest nutrient contents (see also appendix 8, 9 and 10).

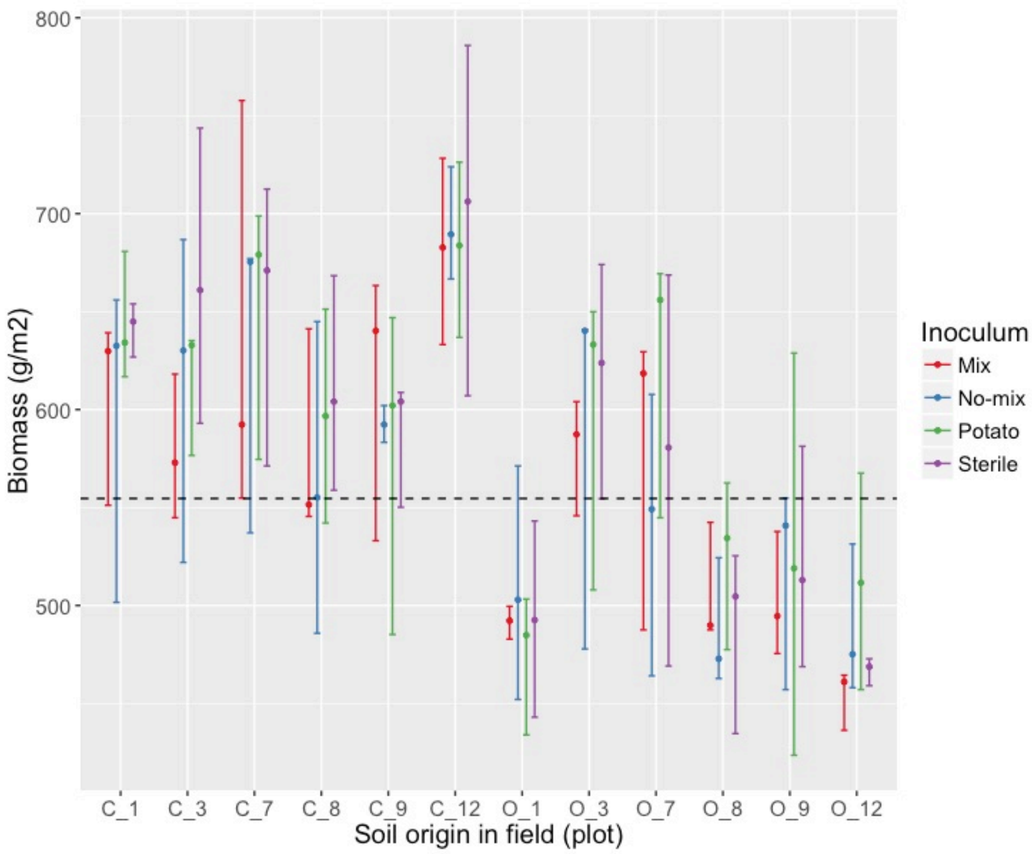

Figure 1 - Effect of soil origin of receptor soil on total aboveground biomass production per added donor soil (inoculum). In field variation of recipient soil resulted in corresponding variations in aboveground DM production. Plot location 1-12 are along field x (see appendix 1 and 2). Dot indicates mean yield. Abbreviations: "C" = conventional management, "O" = organic management.

Effect of individual donor soils on biomass productivity
Comparing the 4 donor soils used in this experiment individually, a clear pattern emerged. Soils under organic management inoculated with a donor soil from a diverse grass-clover system produced the least biomass (Mix organic: 15.49g, P<0.001, std. error=0.549), followed by conventional soils inoculated with this donor soil (Mix conventional: 18.38g, P<0.001, std. error=0.864). No significant difference to those soils inoculated with donor soil from low diversity grass-clover was found for either recipient soils (No-mix Organic: 15.46g, P=0.932, std. error = 0.345; No-mix conventional: 18.35g, P=0.932, std. error=0.345). Donor soils from the control group (not inoculated) showed a marginally significant increase in grass-clover biomass in comparison with inoculated soils (Potato organic: 15.85g, P=0.293, std. error=0.345; Potato conventional: 18.74g, P=0.293, std. error=0.345). Only recipient soils inoculated with sterile donor soil from the

low diversity crop showed a significant increase in productivity (Sterile organic: 16.31g, P=0.020, std. error=0.345; Sterile conventional: 19.20g, P=0.020, std. error=0.345).

Effect of soil inoculation on nutrient uptake

Nitrogen uptake was not dependent on management ($F_{1,10}$=1.48, P=0.25), or donor soil addition ($F_{3,30}$=1.07, P=0.38) and there was no interaction between the two either ($F_{3,30}$=1.34, P=0.28). Plant phosphorus uptake was determined by the recipient soil ($F_{1,10}$=0.93, P=0.36). No significant effect was found for donor soil addition ($F_{3,30}$=0.65, P=0.58) and there was no difference of this effect in the type of management ($F_{3,30}$=1.30, P=0.29). Potassium uptake was dependent on recipient soil ($F_{1,10}$=23.99, P<0.001). No significant effect of inoculation was found ($F_{3,30}$=2.00, P=0.14) and was not dependent on management ($F_{3,30}$=0.68, P=0.57).

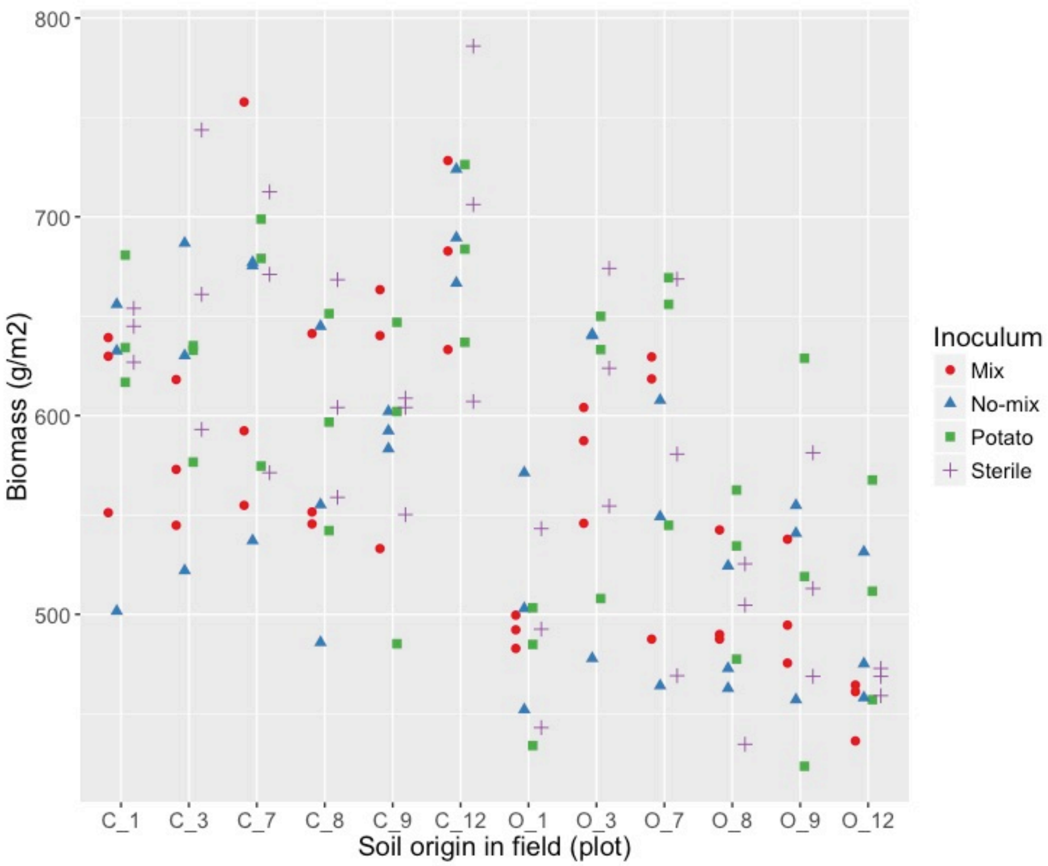

Figure 2 - Overview of observed yields per plot (field origin) and treatment. Abbreviations: "C" = conventional management, "O" = organic management. Number indicates field location of recipient soil as presented in appendix 1 and 2.

Effect of abiotic characteristics on above- and belowground biomass productivity

Inoculation effects were found to be significant comparing inoculated and not inoculated soils. Grass-clover was most productive on soils not inoculated (+0.52g per pot, std. error=0.21, P<0.05). An increase in soil organic matter by 1% (SOM) reduced crop productivity by 3.60g (std. error=0.28, P<0.001) (see table 3 for a full overview).

Table 3 - Effect of abiotic characteristics on dry matter production. Nutrient levels and ranges were measured in mg/kg soil. All values indicate yield decrease or increase in g/pot. Total biomass represents total aboveground biomass.

Soil characteristic		Biomass (g/pot)			
		Clover	Grass	Root	Total
	Intercept	34.06	21.87*	17.71	22.83
SOM (%) **(range: 3.22 – 4.76)**	Value Std. error P-Value	-1.37 0.34 P<0.001	-0.63 0.198 P=0.0018	-3.38 0.445 P<0.001	-3.60 0.287 P<0.001
Soil pH **(range: 5.48 – 6.19)**	Value Std. error P-Value	-2.14 0.848 P=0.0128	-2.05 0.402 P<0.001	-	-
N-NH4 **(range: 1.5-2.61)**	Value Std. error P-Value	-1.39 0.427 P=0.0014	-0.58 0.240 P=0.0166	-	-
N-NO3 **(range: 24.14– 39.63)**	Value Std. error P-Value	-0.28 0.035 P<0.001	-	0.11 0.049 P=0.0238**	0.16 0.032 P<0.001
P-PO4 **(range: 0.7-2.41)**	Value Std. error P-Value	-	-	-	-
Mg **(range: 81.53-172.6)**	Value Std. error P-Value	0.04 0.007 P<0.001	0.03 0.003 P<0.001	0.03 0.011 P=0.0045	0.04 0.007 P<0.001
K **(range: 53.85-161.96)**	Value Std. error P-Value	-0.02 0.006 P=0.0055	-0.02 0.003 P<0.001	-0.02 0.007 P=0.0433**	-0.01 0.005 P=0.0085

*Harvest of plot C_12 were excluded in data for model selection, due to overruling responds to high NO3 levels.
**Including K in the model affected significance of NO3. In model selection K was marginally significant at P=0.04. When K was excluded, NO3 was significant at P=0.0082.

Nutrient effects of donor soils

Significant effects of abiotic soil characteristics on total biomass production (Total DW) were found for: soil organic matter, nitrate, manganese, potassium as well as added nitrate and ammonia in the donor soil. The table below indicates all significant parameters.

Table 4 - Overview of significant, abiotic soil characteristics for total biomass production. First line indicates decrease or increase in yield with increase of given characteristic. Second number is the standard error (SE), followed by corresponding p-values.

Biomass	Intercept	SOM (%)	NO3 ($mg.kg^{-1}$)	Mg ($mg.kg^{-1}$)	K ($mg.kg^{-1}$)	Inoc. NO3 ($mg.kg^{-1}$)	Inoc. NH4 ($mg.kg^{-1}$)
Total DW	24.08g	-3.34g SE 0.300 P<0.001	+0.05g SE 0.010 P<0.001	+0.009 SE 0.002 P<0.001	-0.004g SE 0.001 P=0.0089	-0.813g SE 0.304 P=0.0086	-2.12g SE 0.871 P=0.0166

Inoculation effect of nutrients or biota

To determine whether the found effects of inoculation were caused by the addition of nutrients or soil biota contained in donor soil, total N added was calculated for each inoculum. Through model

selection, significant effects were determined. Soil organic matter ($F_{1,115}$=162, P<0.001), total nitrogen in recipient soil ($F_{1,115}$=92, P<0.001), soil phosphorus content ($F_{1,115}$=25, P<0.001) and nitrogen added through inoculation ($F_{1,115}$=6.08, P=0.0151) significantly determined crop yields.
Plotting total nitrogen addition through inoculation, a clear pattern emerged. Apart from outliers in the "Mix", overall highest nitrogen addition was found in sterile donor soil, which partly corresponded with yield increase. However, addition of recipient soil as donor soil ("Potato"), attained second highest yields, although the least amount of nitrogen was added.

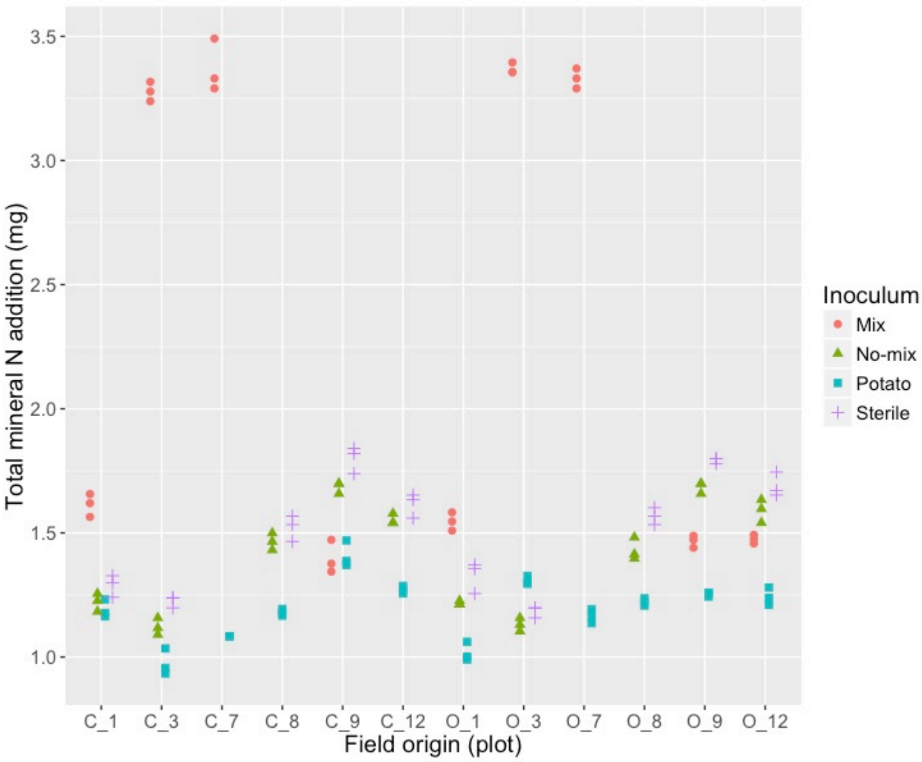

Figure 3 - Nutrient addition in total N for the four donor soils. Inoculation (Mix, No-mix) have high overall N contents. Sterile clover (low diversity) contained same or higher nutrient levels than other clover inocula. Potato soil (home soil) used as donor soil had lowest N concentrations. Abbreviations: "C" = conventional, "O" = organic management.

Results of leaching and additional experiments
Analysing potential effects of soil inoculation on nutrient leaching, no significant effect of recipient soil ($F_{2,152}$=0.89, P=0.41) or inoculation ($F_{4,152}$=1.31, P=0.27) could be found. However, detected nitrogen levels in excess water were very low (max=13.19mg/m2, mean=1.07mg/m2). Total volume of leached water was determined by recipient soil ($F_{2,116}$=92, P<0.001), whereas inoculation had no significant effect ($F_{4,116}$=1.09, P=0.363) and no management specific effect was found ($F_{4,116}$=1.39, P=0.240) (see appendix 11 for more details).

Organic recipient soils inoculated with donor soils from late succession grassland on average yielded 540.46g/m2, which did not significantly differ from those pots inoculated by conspecifics (high and low diversity grass-clover). The last small experiment, where recipient soils from the grass-clover field were inoculated with donor soil from the same field location, showed overall low emergence of sown grass-clover (<60%). Furthermore, yields were lowest on these recipient soils (309.45 g/m2) (see appendix 12 for more details).

5. Discussion

The results of this experiment show that plant productivity can be altered through soil inoculation with donor soil, even when only added in small proportions (2.14% v/v). It was hypothesised that soil life in former potato soils can be improved through inoculation, which results in higher yields of grass-clover grown on inoculated soils compared to non-inoculated soils. However, inoculation significantly reduced total aboveground biomass production and the added volume (75ml, 2,14% of total soil) closely equalled average yield reduction in inoculated soils (0.52g, 2,3% of total biomass per pot). The hypothesis of increased production through soil inoculation in an arable crop system was therefore rejected, as overall yields decreased through inoculation.
This was in line with studies demonstrating that early and late successional plants are impacted differently by soil biota. Early successional plants were found to be reduced by conditioned soils and contained soil biota, whereas later successional plants were promoted (Kardol et al. 2006; Middleton & Bever, 2012). Both crops grown in this experiment and most crops used in arable systems are early successional plants, which provide high biomass productivity over short periods of time. Although several studies indicate that effects of soil biota and soil conditioning are negative on early succession crops (Kardol et al. 2006; Hendriks et al. 2013), these effects were mainly observed in experimental monocultures. When growing plant associations, community feedback on early succession plants was found to be positive in mixed crops (Jing, Bezemer and Van der Putten 2015). Although a crop mixture was used in this experiment, these findings cannot be confirmed by the results of this study. However, earlier studies and the current results strongly indicate that PSF effects highly vary along successional positions as well as chosen crop mixtures.

Based on the strong connection of above- and belowground diversity, it was hypothesised that the crop performs best when inoculated with donor soil conditioned by a genetic diverse grass-clover mixture. In this experiment, pots inoculated with these donor soils resulted in the lowest yields. In line with other studies, plants inoculated with soil conditioned by conspecifics (grass-clover) attained significantly lower yields than those inoculated with soils from heterospecifics (potato) or sterile soil (Hendriks et al. 2013; Wubs and Bezemer 2016). However, the hypothesis that diverse aboveground biodiversity relates to a more complex belowground diversity can potentially be supported by these findings. Plant productivity was most affected by donor soil from diverse systems, which was collected from fields with high genetic aboveground diversity. These soils were conditioned by a range of conspecifics, therefore providing a more stable inoculum and increasing negative feedback effects on the crop (Kardol et al. 2006; Middleton & Bever 2012).
Although the nitrogen addition through inoculation proved to have a significant effect on aboveground biomass production, nutrient levels were not a reliable predictor of yields (see Figure 3; Appendix 8-10). Recipient soils inoculated with a donor soil from genetically diverse grass-clover received highest nitrogen additions, but had lowest yields. The differences in growth between the donor soils could thus not solely be explained by nutrient availability after donor soil addition. The results suggest that plant species-specific soil biota, transplanted by donor soils, contributed to the decrease in yields, which is in line with earlier findings (Kardol et al. 2006; Hendriks et al. 2013).

The third hypothesis assumed that conventional production of potatoes is more detrimental for soil life than organic production, which should have resulted in overall larger effects of inoculation with donor soils in conventional soils. However, the response of crop productivity was not dependent on the management. Although prior research has shown that management practices can alter decomposer succession and biota composition in general, no difference in response to inoculation could be observed in this experiment (Gosling et al. 2006, Li et al. 2012; Rashid et al. 2013; Henneron et al. 2015). However, notably more weeds emerged from recipient soils under organic management than from those under conventional management. All weeds germinating from the

seed bank were removed during the first 6 weeks, to eliminated competition. Potential effects on competition were therefore excluded from this experiment.
Overall, recipient soils were mainly determining biomass productivity. In line with these results, other studies indicated predominant effects of abiotic characteristics of recipient soils, even when inoculated with donor soils in higher proportions (Carbajo et al. 2011). High nutrient levels of conventional recipient soils resulted in overall higher yields. Although these differences in nutrient levels could have been evened out through fertiliser addition, it was decided not to apply fertiliser as effects of nutrients addition might have overruled effects of soil inoculation. Furthermore, the chosen setup allowed to study inoculation effects at different nutrient levels, which are known to affect PSF (De Deyn et al. 2004; Kos et al. 2015).
Wubs and Bezemer (2016) stressed that spatial dynamics in PSF need to be incorporated in empirical studies. The high variation in yields across all plots and both managements confirms the importance of spatial variation in the context of empirical PSF studies as well as the relevance for inoculation studies (see Figure 1, Appendix 8&10). More attention should be focussed on these dynamics in future studies.

Additional experiments
In the current experiment, it was decided to conduct the leaching experiment after crop establishment. The overall observed nutrient losses in both leaching experiments were low, which can be explained by the time when samples were taken. Available nutrients potentially prone to leaching had already been taken up by plants during strong growth of first 6 weeks. This is especially true for crops grown on organic soils, where signs of emerging nitrogen and potassium deficiency were observed during the last 2 to 3 weeks of the experiment.
The small sample of grass-clover grown on soil conditioned by conspecifics for 2 years showed strong, negative PSF effects. Crop establishment and productivity were negatively affected and yields were cut by almost 50%. The results support earlier findings and provide strong indication for negative PSF in grass-clover (Wubs & Bezemer 2016).
Lastly, inoculation of field soils with donor soils from late succession grasslands did not alter crop response. Grass-clover yield reduction was comparable to those soils treated with donor soil conditioned for 2 years. The results indicate that successional position of aboveground and correspondingly belowground diversity does not necessarily alter inoculation effects.

Limitations of study
This experiment focussed on elaborating the effect of applying inoculation in an agricultural context. All steps of the methodology were set out to mirror an on-farm approach. The application of the donor soil in such small proportions and the application in the top layer might not reflect optimal conditions for best results. Mixing the donor soil with the recipient soil would increase the contact depth and potentially the strength of effect on the crop. However, this approach was neglected as it would require the farmer to apply highly invasive measures on recipient soils, thus damaging all existing soil biota. Mixing the donor soil with the top layer (2 to 3 cm), can easily be applied with existing machinery and is a none- or low-invasive measure. Further, grass-clover is harvested and processed as one crop in arable systems. It was therefore chosen to analyse nutrient uptake per pot, as this reflects the nutrients available in the crop. Further, roots were sampled per pot, not accounting for potential increases in nodule formation of clovers.
This experiments provides strong indication that the inoculation of soils can alter the productivity of agricultural land even if applied on a large scale. It is suggested to further research this topic and elaborate beneficial combinations of donor soil and crop.

6. Conclusion

The results of this experiment contribute to a new perspective for the implementation of soil inoculation in an agricultural context. It is shown that biomass productivity of an arable crop can be altered through the addition of donor soils as inoculum. Inoculating potato soils with donor soils reduced aboveground grass-clover productivity. The effect of inoculation was significant for all four donor soils on recipient soils under organic and conventional management. However, no clear effect in strength of response could be linked to either management practice. Results indicate that inoculating potato soils with donor soils can alter yields of subsequent grass-clover crops. Although nutrient effects from the donor soil significantly affected crop productivity, variation in yield could not simply be explained by added nutrients. This provided strong evidence that small additions of soil biota were the main factor altering yields.

From the results of the current experiment, application in arable systems was found not to be beneficial. Inoculation effects were negative on early establishment of grass-clover and overall productivity. While results of this experiment were negative in the given arable system, they provide strong indication that the inoculation of field soils with donor soil can be a measure to shift crop productivity. Application in other cropping systems with potentially positive effects should be explored. The possibility of implementing donor soil addition in a crop rotation was proven to be possible in this experiment but needs further exploration. Spatial heterogeneity of recipient soils had a strong effect on attained yields and needs to be implemented in experimental designs of future empirical studies.

Under controlled conditions, it was demonstrated that the origin of recipient soil was of greater importance than the added donor soil, but addition in small proportions could still alter productivity. Further experiments are required to quantify these findings under field conditions and to determine whether inoculation effects are stable throughout a longer time span.

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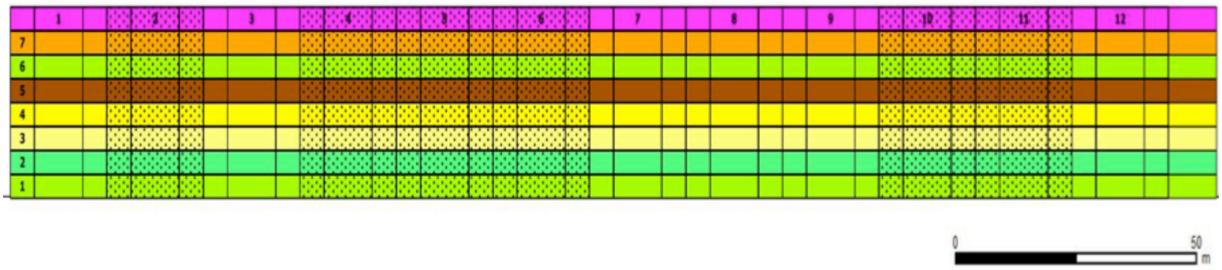
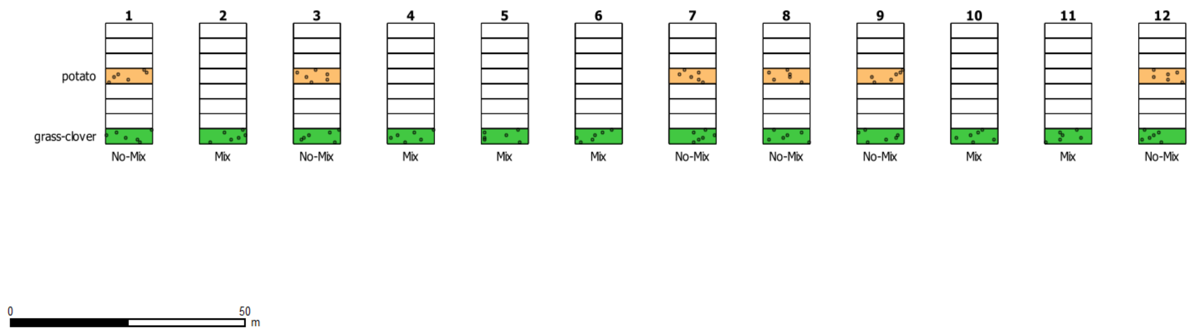
Appendixes

Appendix 1 – Overview of the field layout of the rotational experiment used as source for receptor soil of potatoes (strip 5) and source of the donor soil (inoculum) of grass clover mixtures (strip 1), both under organic management. Dotted areas indicate a mixture of high diversity, blank plots are monocultures. All plots have a size of 10m x 3m and are connected by a 5m buffer zone for each treatment.



Appendix 2 – Overview of samples locations for potato soil from rotational experiment (strip 5) and grass-clover (strip 1). For soil sampling, each plot was discretised into 20x6 cells, each covering 50x50cm. The plot then consisted of 6 rows and 20 columns. Per plot 6 randomly chosen samples were taken (one per row), indicated by the dots. These were sieved and mixed into one composite sample per plot, used as receptor soil (potato) or inoculum (grass-clover). Same pattern for conventional soil. Soil was inoculated with donor soil from same field x location in the rotation experiment (O_1 + CNM_1).



Appendix 3 – Abiotic characteristics of recipient soils at the start of the experiment.

Soil	Plot	NH_4 (mg.kg-1)	NO_3 (mg.kg^{-1})	P-PO4 (mg.kg^{-1})	K (mg.kg^{-1})	Mg (mg.kg^{-1})	pH (H_2O)	% OM
C	C_1	1.91	29.97	2.41	88.10	104.8	5.48	3.22
C	C_3	1.61	24.14	1.91	98.16	103.6	5.89	3.31
C	C_7	1.50	32.40	2.00	134.70	172.6	5.98	4.00
C	C_8	1.89	29.72	1.70	106.60	144.6	5.95	3.68
C	C_9	2.42	29.47	2.04	89.20	130.4	5.69	3.69
C	C_12	2.01	39.63	1.91	132.36	149.7	5.86	3.52
O	O_1	1.81	24.37	1.20	161.96	133.0	6.19	4.04
O	O_3	2.61	26.98	1.20	82.44	135.5	6.00	3.92
O	O_7	2.41	25.34	1.61	77.95	126.5	6.10	3.68
O	O_8	2.33	29.64	1.11	60.90	137.6	6.03	4.52
O	O_9	2.31	30.89	1.00	69.00	131.6	6.00	4.76
O	O_12	2.31	26.07	0.70	53.85	81.5	6.13	4.16

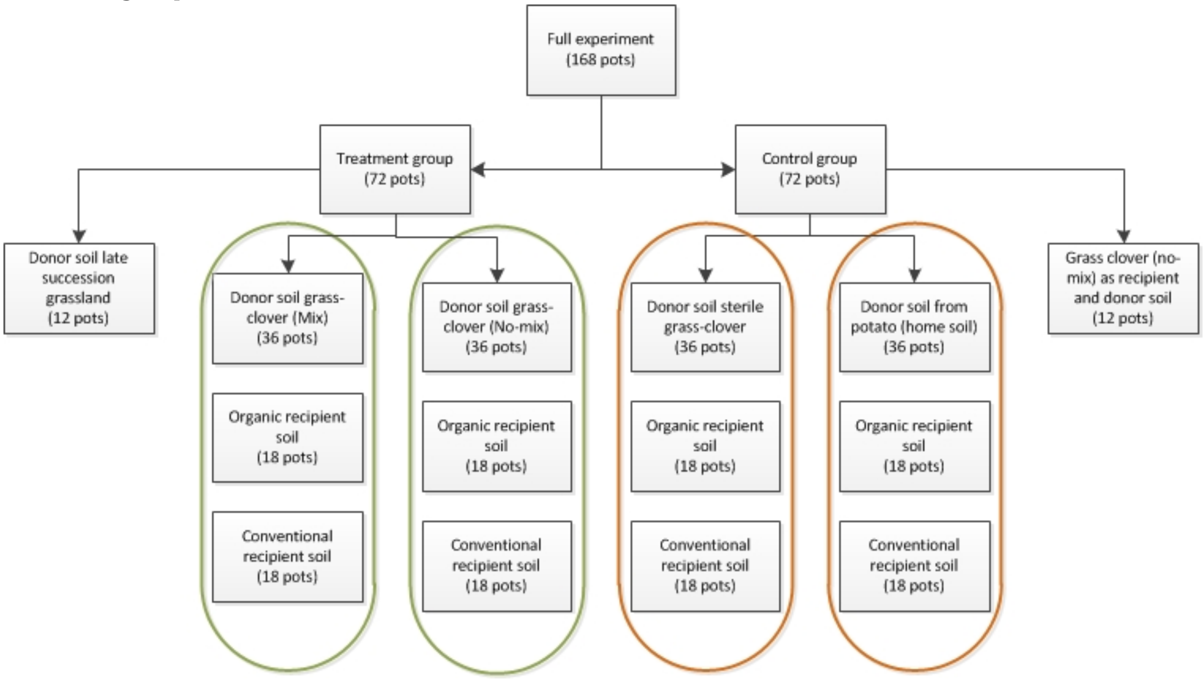
Appendix 4 – Abiotic characteristics of donor soil used as inoculum at the start of the experiment. The plant association grown on these soils was red clover (*Trifolium pratense lucrum*) and Italian ryegrass (*Lolium multiflorum*). Sample 7 has not been recorded.

Soil	Plot	NH_4 (mg.kg-1)	NO_3 (mg.kg^{-1})	P-PO4 (mg.kg^{-1})	K (mg.kg^{-1})	Mg (mg.kg^{-1})	pH	% OM
CL	CL_1	2.41	26.88	1.00	29.38	119.8	5.87	4.23
CL	CL_3	2.31	24.34	0.80	35.70	109.9	5.59	4.34
CL	CL_7	-	-	-	-	-	-	-
CL	CL_8	2.89	31.21	0.80	22.14	88.0	5.59	4.25
CL	CL_9	3.72	33.59	0.70	32.59	94.7	5.53	4.58
CL	CL_12	3.32	31.98	0.70	25.24	106.8	5.67	4.54

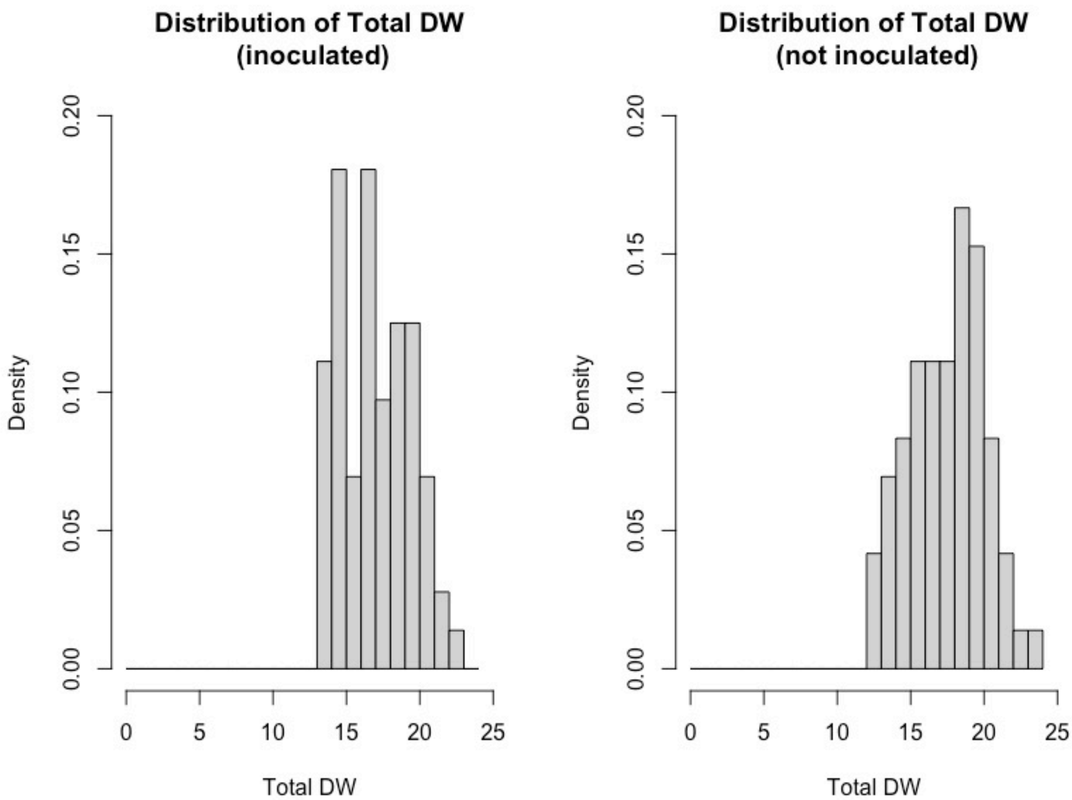
Appendix 5 – Abiotic characteristics of clover soil used in additional experiment to analyse the effects of grass-clover sown after grass clover. Plant association grown in this experiment was red clover (*Trifolium pratense lucrum*) and Italian ryegrass (*Lolium multiflorum*). Results for plot 6 and 7 have not been recorded.

Soil	Plot	NH_4 (mg.kg-1)	NO_3 (mg.kg^{-1})	P-PO4 (mg.kg^{-1})	K (mg.kg^{-1})	Mg (mg.kg^{-1})	pH	% OM
CL	CL_1	2.41	26.88	1.00	29.38	119.8	5.87	4.23
CL	CL_2	3.30	31.60	0.90	49.50	99.4	5.65	4.23
CL	CL_3	2.31	24.34	0.80	35.70	109.9	5.59	4.34
CL	CL_4	12.44	2.41	0.60	39.01	137.7	6.08	4.22
CL	CL_5	12.84	1.91	0.70	46.03	124.4	6.04	4.36
CL	CL_6	-	-	-	-	-	-	-
CL	CL_7	-	-	-	-	-	-	-
CL	CL_8	2.89	31.21	0.80	22.14	88.0	5.59	4.25
CL	CL_9	3.72	33.59	0.70	32.59	94.7	5.53	4.58
CL	CL_10	3.52	19.75	0.78	27.67	104.2	5.76	4.56
CL	CL_11	3.00	31.10	0.80	31.20	115.8	5.92	4.48
CL	CL_12	3.32	31.98	0.70	25.24	106.8	5.67	4.54

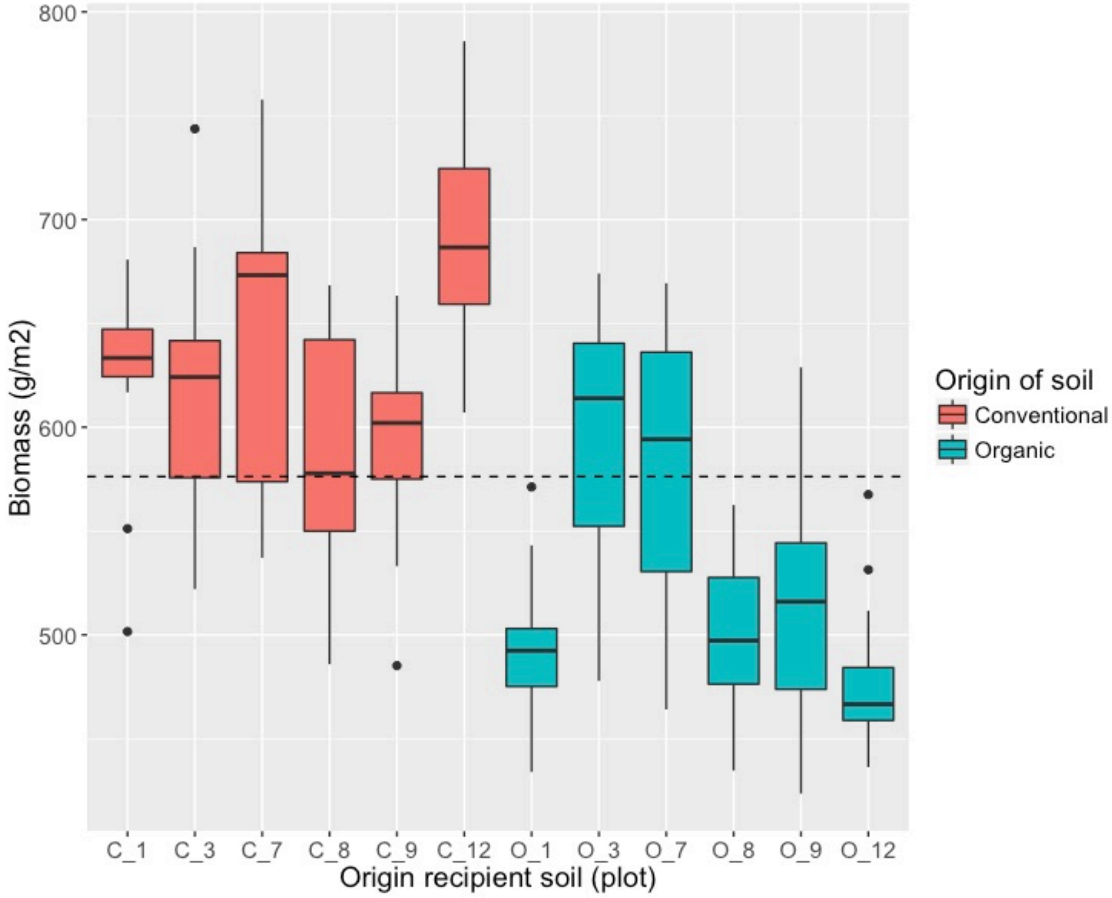
Appendix 6 – Conceptual representation of the experimental design. Treatment group (72 pots) and control group (72 pots) are circled. Additional experiments included as separate parts of either treatment of control group.



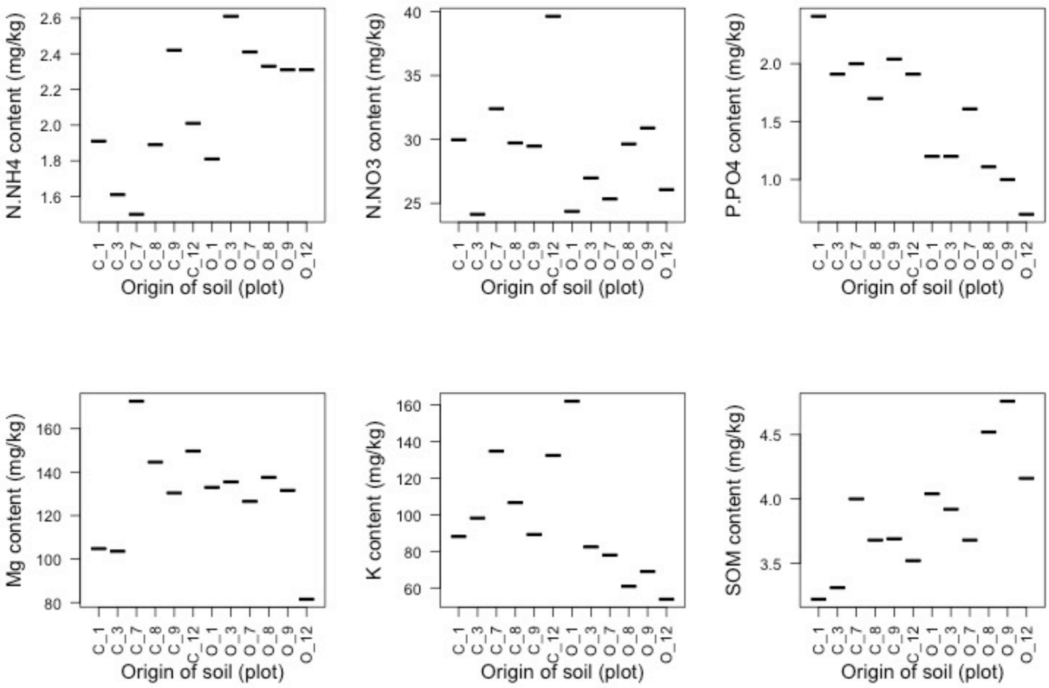
Appendix 7 – Distribution in treatment (inoculated) and control group (non-inoculated) of the experiment.



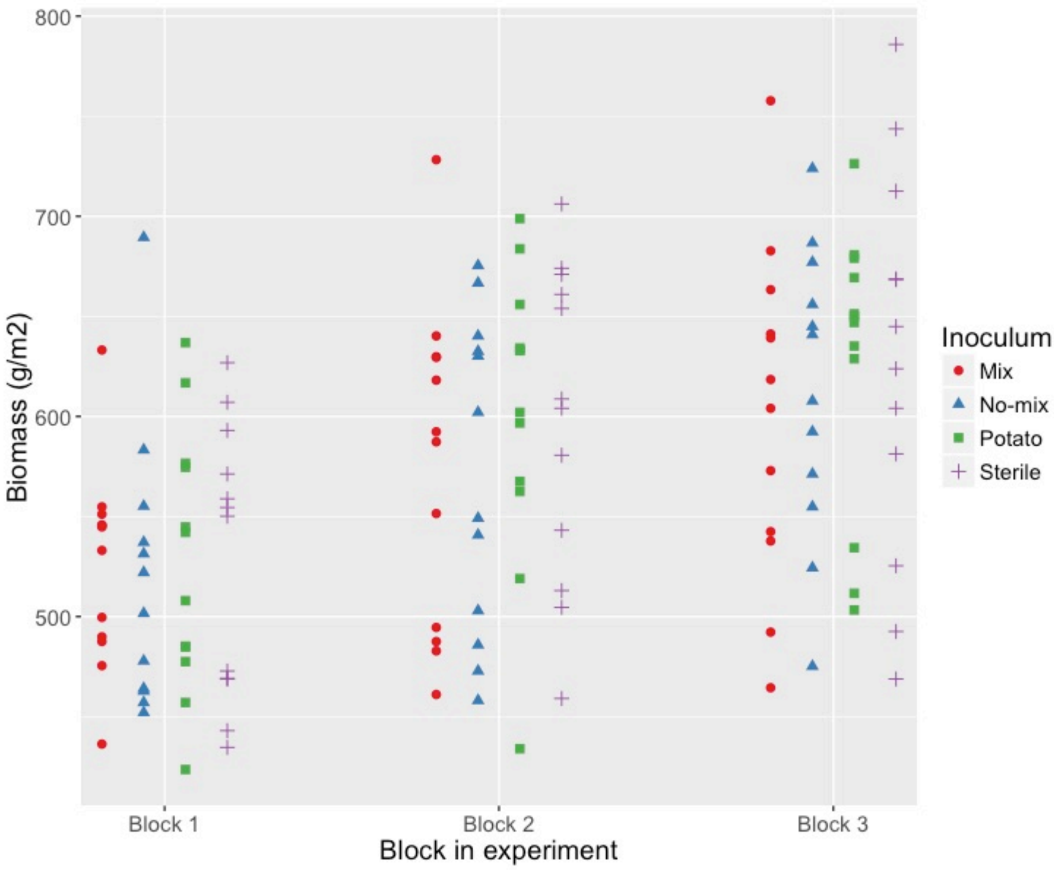
Appendix 8 – Aboveground biomass productivity per plot of recipient soil. Variation in responses over field location indicates potential differences in nutrient availability. Dotted line represents overall yield average (576.2 g/m2).



Appendix 9 - All nutrient levels in all plots used as recipient soil. Conventional soils tended to have higher concentrations of NO3 and K (especially C_12). Organic soils showed overall higher SOM concentrations.



Appendix 10 – Overview of aboveground biomass produced per treatment and block, not accounting for recipient soils.



Appendix 11 - Additional experiment 1: Effect of soil inoculation of leaching of nutrients
During the last 4 weeks of the experiment, two strong rainfalls were simulated to provoke leaching of remaining nutrients. This was done after crop establishment, as the increased water demand reduced risks of water logging. Nutrient leaching was measured in excessive water collected in plastic bags hung in the cachepots. Per pot, 1.5 litres of water were added, to provoke leaching. After 24 hours, excessive water was collected, measured a sub-sample was taken for a composite sample of both leaching incidents. The composite samples were then analysing for containing nutrients.

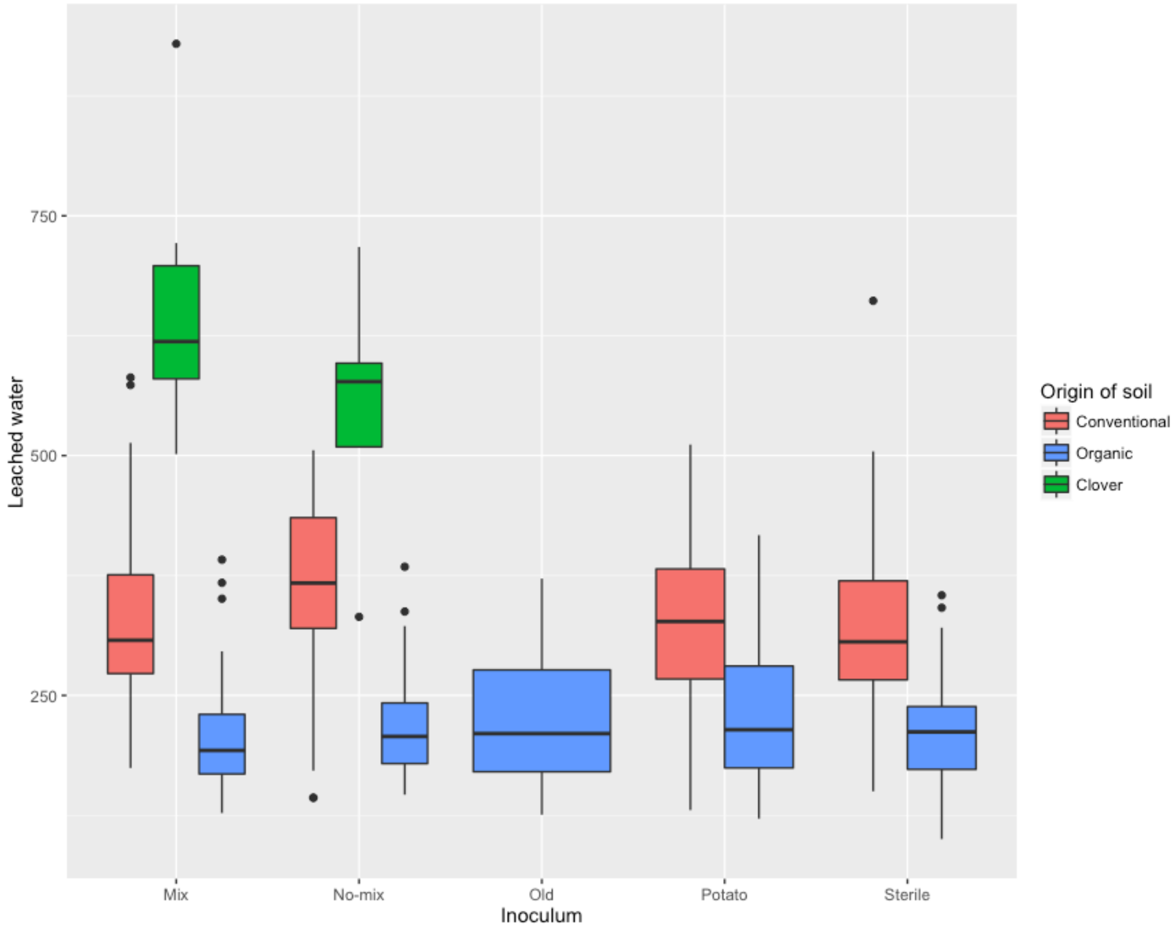


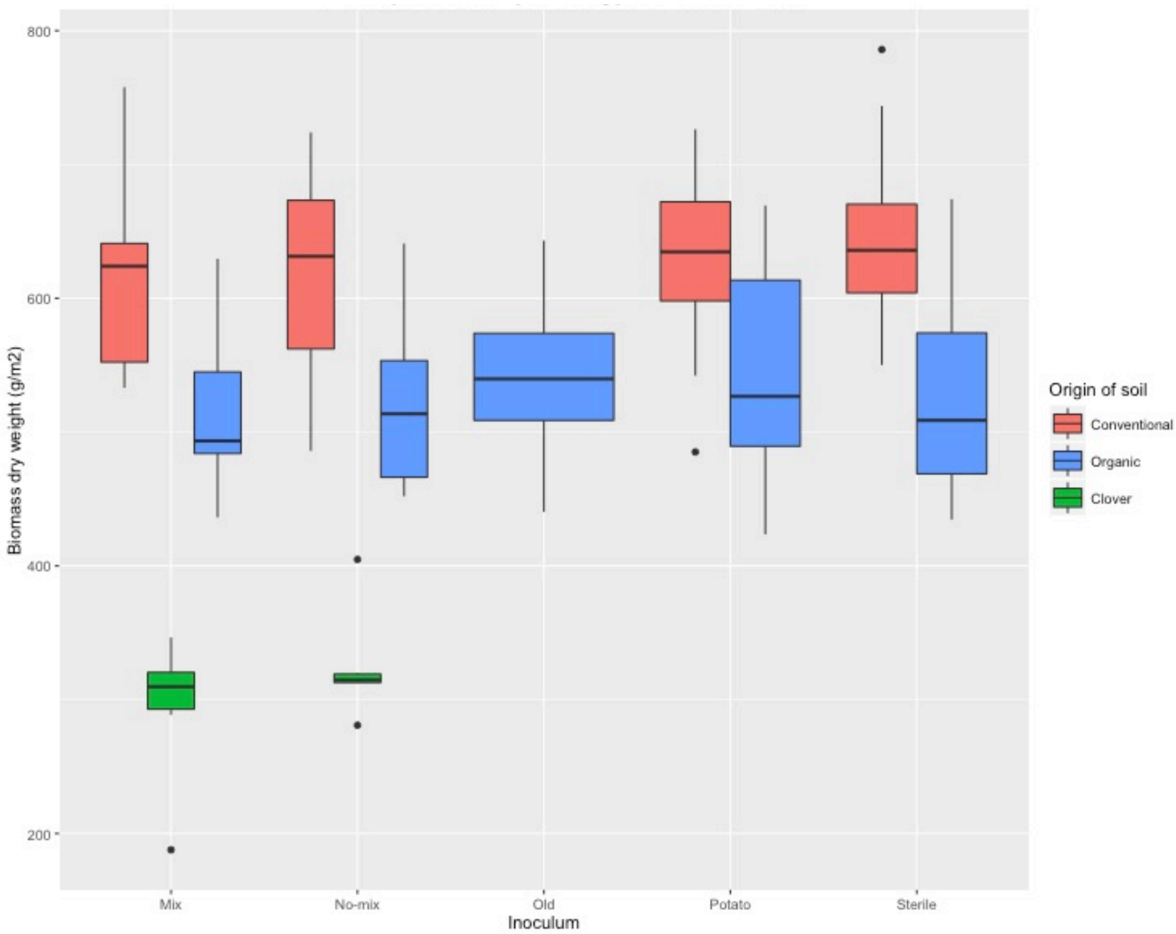
Figure I - Overview results leaching experiment. Water retention showed significant difference between clover recipient soil and potato soil under conventional or organic management. Clover recipient soils were stronger compacted when pot were filled, leading to a lower infiltration rate. Nutrient levels in residues were below detectable range, indicating low or no access nutrients to be leached.

Analysing effect of experimental factors, the following model was used:

$$\text{Infiltration (ml)} = \text{Management} * \text{Inoculum} + (1|\text{Block}/\text{Plot})$$

A clear effect of management could be distinguished ($F_{2,116}$=92, P<0.001), whereas inoculation did not show any significant effect ($F_{4,116}$=1.1, P=0.363). Interaction between the two was also found not significant ($F_{4,115}$=1.394, P=0.24). The same results were found for the effect on leached Nitrogen, which was only dependent on management ($F_{2,116}$=92, P<0.001). It can thus be concluded that soil inoculation did not influence leaching of nutrients. However, it is likely that by the time leaching experiments were conducted, soil available N was already depleted and thus no N could be leached.

Appendix 12 - Overview of all yields for 5 donor soils and 3 field soils (management).
Main experiment consisted of conventional and organic soils (red and blue), inoculated with grass-clover soils (Mix, No-mix), sterile grass-clover soil (Sterile) and potato soil from the same location as recipient soil (Potato). Additional experiment covered a small sample of clover soils, where the same grass-clover mixture was sown as present in the field. Further, recipient soil under organic management was inoculated with a donor soil collected from late successional grassland (Old).



Appendix 13 – Part 1 of 2 of the table containing all collected data from current experiment. Pot 1-56 were placed in block 1 of experiment, 57-112 in block 2 and 113-168 were place in block 3.

General information						Harvest data						Soil properties							Leaching experiment									Root samples	
Pot Nr.	Plot	Management	Treatment	Treatment2	Total WW	Grass WW	Clover WW	Total DW	Grass DW	Clover DW	Date harvested	Soil pH	SOM (%)	N-NH4 (mg/kg)	P-PO4 (mg/kg)	N-NO3 (mg/kg)	K (mg/kg)	Mg (mg/kg)	Water added (ml)	Leaching (g)	Water holding (ml)	Date leaching	N-NH4(mg/l)	N-NO3(mg/l)	Leaching 2 (g)	Water holding 2 ml	Date leaching 2	Root DW(g)	Date root sampled
1	O_1	O	CNM_1	No-mix	62.64	23.46	39.18	13.5	6.12	7.38	08.02.16	6.19	4.04	1.81	1.20	24.37	161.96	132.98	1200	211.2	988.8	18.01.16	0.03	0.01	292.30	907.70	05.02.16	7.24	24.02.16
2	O_3	O	CNM_3	No-mix	69.67	27.79	41.88	14.27	6.76	7.51	08.02.16	6.00	3.92	2.61	1.20	26.98	82.44	135.49	1200	197.1	1002.9	18.01.16	0.03	0.01	173.20	1026.80	05.02.16	7.88	24.02.16
3	O_7	O	CNM_7	No-mix	64.90	23.53	41.37	13.86	5.82	8.04	08.02.16	6.10	3.68	2.41	1.61	25.34	77.95	126.52	1200	337.4	862.6	18.01.16	0.21	0.02	302.30	897.70	05.02.16	8.34	24.02.16
4	O_8	O	CNM_8	No-mix	61.16	33.83	27.33	13.82	8.85	4.97	08.02.16	6.03	4.52	2.33	1.11	29.64	60.90	137.57	1200	322.3	877.7	18.01.16	0.01	0.00	149.80	1050.20	05.02.16	9.01	24.02.16
5	O_9	O	CNM_9	No-mix	64.87	31.24	33.63	13.65	7.62	6.03	08.02.16	6.00	4.76	2.31	1.00	30.89	69.00	131.58	1200	384.1	815.9	18.01.16	1.03	0.00	144.60	1055.40	05.02.16	6.82	24.02.16
6	O_12	O	CNM_12	No-mix	76.28	28.16	48.12	15.87	7.06	8.81	08.02.16	6.13	4.16	2.31	0.70	26.07	53.85	81.53	1200	146.5	1053.5	18.01.16	0.07	0.00	91.00	1109.00	05.02.16	10.19	24.02.16

24.02.16	24.02.16	23.02.16	24.02.16	24.02.16	23.02.16	24.02.16	24.02.16
12.67	9.16	12.69	10.5	12.84	13.27	6.65	9.6
05.02.16	05.02.16	05.02.16	05.02.16	05.02.16	05.02.16	05.02.16	05.02.16
956.70	992.40	932.20	869.70	845.60	849.10	911.10	916.20
243.30	207.60	267.80	330.30	354.40	350.90	288.90	283.80
0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.00
0.01	0.00	0.05	0.00	0.08	0.04	0.00	0.32
18.01.16	18.01.16	18.01.16	18.01.16	18.01.16	18.01.16	18.01.16	18.01.16
750.2	1028.5	694.4	791.6	729.7	755.8	1200.0	1009.8
449.8	171.5	505.6	408.4	470.3	444.2		190.2
1200	1200	1200	1200	1200	1200	1200	1200
104.80	103.59	172.60	144.59	130.40	149.66	119.84	132.98
88.10	98.16	134.70	106.60	89.20	132.36	29.38	161.96
29.97	24.14	32.40	29.72	29.47	39.63	26.88	24.37
2.41	1.91	2.00	1.70	2.04	1.91	1.00	1.20
1.91	1.61	1.50	1.89	2.42	2.01	2.41	1.81
3.22	3.31	4.00	3.68	3.69	3.52	4.23	4.04
5.48	5.89	5.98	5.95	5.69	5.86	5.87	6.19
08.02.16	08.02.16	08.02.16	08.02.16	08.02.16	08.02.16	08.02.16	08.02.16
7.45	8.94	7.82	9.23	9.14	7.52	2.00	8.72
7.53	6.65	8.22	7.35	8.28	13.07	7.45	6.20
14.98	15.59	16.04	16.58	17.42	20.59	9.45	14.92
45.30	53.58	42.53	53.35	47.68	45.38	8.54	45.07
33.84	28.97	35.46	33.68	36.12	57.87	30.29	24.62
79.14	82.55	77.99	87.03	83.80	103.25	38.83	69.69
No-mix	No-mix	No-mix	No-mix	No-mix	No-mix	No-mix	Mix
CNM_1	CNM_3	CNM_7	CNM_8	CNM_9	CNM_12	CNM_1	CM_2
C	C	C	C	C	C	CL	O
C_1	C_3	C_7	C_8	C_9	C_12	CL_1	O_1
7	8	9	10	11	12	13	14

15	O_3	O	CM_4	Mix	74.18	29.14	45.04	16.3	7.63	8.67	08.02.16	6.00	3.92	2.61	1.20	26.98	82.44	135.49	1200	295.9	904.1	18.01.16	0.30	0.01	131.60	1068.40	05.02.16	14.26	23.02.16
16	O_7	O	CM_5	Mix	61.93	27.19	34.74	14.56	7.35	7.21	08.02.16	6.10	3.68	2.41	1.61	25.34	77.95	126.52	1200	367.4	832.6	18.01.16	0.00	0.01	139.40	1060.60	05.02.16	8.53	24.02.16
17	O_8	O	CM_6	Mix	64.98	28.96	36.02	14.63	7.88	6.75	08.02.16	6.03	4.52	2.33	1.11	29.64	60.90	137.57	1200	391.5	808.5	18.01.16	0.00	0.00	123.40	1076.60	05.02.16	7.28	24.02.16
18	O_9	O	CM_10	Mix	65.48	25.61	39.87	14.2	6.63	7.57	08.02.16	6.00	4.76	2.31	1.00	30.89	69.00	131.58	1200	350.8	849.2	18.01.16	0.00	0.01	106.40	1093.60	05.02.16	9.16	24.02.16
19	O_12	O	CM_11	Mix	64.01	24.44	39.57	13.03	5.79	7.24	08.02.16	6.13	4.16	2.31	0.70	26.07	53.85	81.53	1200	184.9	1015.1	18.01.16	0.05	0.00	99.00	1101.00	05.02.16	8.19	24.02.16
20	C_1	C	CM_2	Mix	82.45	38.26	44.19	16.46	8.89	7.57	08.02.16	5.48	3.22	1.91	2.41	29.97	88.10	104.80	1200	467.4	732.6	18.01.16	0.02	0.01	191.70	1008.30	05.02.16	14.55	24.02.16
21	C_3	C	CM_4	Mix	83.93	32.99	50.94	16.27	7.69	8.58	08.02.16	5.89	3.31	1.61	1.91	24.14	98.16	103.59	1200	368.5	831.5	18.01.16	0.06	0.01	235.50	964.50	05.02.16	11.23	24.02.16
22	C_7	C	CM_5	Mix	89.69	36.13	53.56	16.57	8.14	8.43	08.02.16	5.98	4.00	1.50	2.00	32.40	134.70	172.60	1200	304.1	895.9	18.01.16	0.00	0.00	371.80	828.20	05.02.16	10.86	24.02.16

23	C_8	C	CM_6	Mix	81.07	32.96	48.11	16.29	7.48	8.81	08.02.16	5.95	3.68	1.89	1.70	29.72	106.60	144.59	1200	573.6	626.4	18.01.16	0.03	0.02	416.30	783.70	05.02.16	10.56	24.02.16
24	C_9	C	CM_10	Mix	84.18	50.23	33.95	15.92	7.24	8.68	08.02.16	5.69	3.69	2.42	2.04	29.47	89.20	130.40	1200	581.4	618.6	18.01.16	0.04	0.02	370.70	829.30	05.02.16	10.1	24.02.16
25	C_12	C	CM_11	Mix	93.37	57.00	36.37	18.91	13.33	5.58	08.02.16	5.86	3.52	2.01	1.91	39.63	132.36	149.66	1200	513.3	686.7	18.01.16	0.31	0.03	309.20	890.80	05.02.16	10.26	24.02.16
26	CL_4	CL	CM_4	Mix	44.02	39.48	4.54	9.36	8.31	1.05	08.02.16	6.08	4.22	12.44	0.60	2.41	39.01	137.69	1200	721.6	478.4	18.01.16	0.00	0.01	525.60	674.40	05.02.16	5.83	24.02.16
27	O_1	O	CS_1	Sterile	62.89	23.20	39.69	13.23	5.58	7.65	08.02.16	6.19	4.04	1.81	1.20	24.37	161.96	132.98	1200	163.4	1036.6	18.01.16	0.11	0.01	379.90	820.10	05.02.16	6.71	24.02.16
28	O_3	O	CS_3	Sterile	76.97	30.44	46.53	16.56	7.66	8.90	08.02.16	6.00	3.92	2.61	1.20	26.98	82.44	135.49	1200	231.1	968.9	18.01.16	0.01	0.01	144.00	1056.00	05.02.16	11.21	24.02.16
29	O_7	O	CS_7	Sterile	71.47	31.78	39.69	14.01	7.08	6.93	08.02.16	6.10	3.68	2.41	1.61	25.34	77.95	126.52	1200	341.4	858.6	18.01.16	0.01	0.02	59.30	1140.70	05.02.16	9.08	24.02.16
30	O_8	O	CS_8	Sterile	59.96	27.57	32.39	12.98	6.82	6.16	08.02.16	6.03	4.52	2.33	1.11	29.64	60.90	137.57	1200	320.6	879.4	18.01.16	0.03	0.01	98.90	1101.10	05.02.16	8.51	24.02.16

31	O_9	O	CS_9	Sterile	64.70	30.90	33.80	14	7.68	6.32	08.02.16	6.00	4.76	2.31	1.00	30.89	69.00	131.58	1200	354.4	845.6	18.01.16	0.03	0.01	205.50	994.50	05.02.16	7.88	23.02.16
32	O_12	O	CS_12	Sterile	66.53	26.64	39.89	14.12	6.65	7.47	08.02.16	6.13	4.16	2.31	0.70	26.07	53.85	81.53	1200	295.3	904.7	18.01.16	0.03	0.01	457.40	742.60	05.02.16	7.62	24.02.16
33	C_1	C	CS_1	Sterile	89.29	36.00	53.29	18.72	8.69	10.03	08.02.16	5.48	3.22	1.91	2.41	29.97	88.10	104.80	1800	661.4	1138.6	18.01.16	0.00	0.00	289.60	1510.40	05.02.16	12.55	24.02.16
34	C_3	C	CS_3	Sterile	85.70	32.48	53.22	17.71	8.24	9.47	08.02.16	5.89	3.31	1.61	1.91	24.14	98.16	103.59	1200	310.5	889.5	18.01.16	0.08	0.01	171.30	1028.70	05.02.16	9.11	24.02.16
35	C_7	C	CS_7	Sterile	88.46	40.76	47.70	17.06	9.02	8.04	08.02.16	5.98	4.00	1.50	2.00	32.40	134.70	172.60	1200	467.8	732.2	18.01.16	0.08	0.02	363.00	837.00	05.02.16	8.52	24.02.16
36	C_8	C	CS_8	Sterile	69.48	33.66	35.82	16.69	7.86	8.83	08.02.16	5.95	3.68	1.89	1.70	29.72	106.60	144.59	1200	333.1	866.9	18.01.16	0.01	0.01	358.80	841.20	05.02.16	9.22	24.02.16
37	C_9	C	CS_9	Sterile	86.15	37.71	48.44	16.43	8.24	8.19	08.02.16	5.69	3.69	2.42	2.04	29.47	89.20	130.40	1200	504.4	695.6	18.01.16	0.07	0.01	275.20	924.80	05.02.16	10.27	24.02.16
38	C_12	C	CS_12	Sterile	89.87	51.27	38.60	18.13	12.11	6.02	08.02.16	5.86	3.52	2.01	1.91	39.63	132.36	149.66	1200	410	790.0	18.01.16	0.04	0.01	372.90	827.10	05.02.16	12.91	23.02.16

23.02.16	23.02.16	23.02.16	24.02.16	24.02.16	24.02.16	24.02.16	24.02.16
8.36	9.68	14.55	11.5	7.87	6.19	7.32	10.92
05.02.16	05.02.16	05.02.16	05.02.16	05.02.16	05.02.16	05.02.16	05.02.16
590.90	1018.30	1055.20	988.40	1087.70	1100.40	825.90	892.20
609.10	181.70	144.80	211.60	112.30	99.60	374.10	307.80
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
0.02	0.05	0.15	0.08	0.19	0.15	0.20	0.22
18.01.16	18.01.16	18.01.16	18.01.16	18.01.16	18.01.16	18.01.16	18.01.16
622.9	930.0	872.2	876.2	944.6	782.9	1014.6	730.7
577.1	270	327.8	323.8	255.4	417.1	185.4	469.3
1200	1200	1200	1200	1200	1200	1200	1200
	132.98	135.49	126.52	137.57	131.58	81.53	104.80
	161.96	82.44	77.95	60.90	69.00	53.85	88.10
	24.37	26.98	25.34	29.64	30.89	26.07	29.97
	1.20	1.20	1.61	1.11	1.00	0.70	2.41
	1.81	2.61	2.41	2.33	2.31	2.31	1.91
	4.04	3.92	3.68	4.52	4.76	4.16	3.22
	6.19	6.00	6.10	6.03	6.00	6.13	5.48
08.02.16	08.02.16	08.02.16	08.02.16	08.02.16	08.02.16	08.02.16	08.02.16
1.40	8.51	7.34	8.52	7.58	5.62	6.62	10.66
8.16	5.97	7.83	7.75	6.68	7.03	7.03	7.76
9.56	14.48	15.17	16.27	14.26	12.65	13.65	18.42
5.60	44.05	35.51	48.81	41.54	31.51	33.18	58.87
32.37	23.92	29.71	33.22	27.11	30.36	27.28	33.24
37.97	67.97	65.22	82.03	68.65	61.87	60.46	92.11
No-mix	Potato	Potato	Potato	Potato	Potato	Potato	Potato
CNM_7	PO_1	PO_3	PO_7	PO_8	PO_9	PO_12	PC_1
CL	O	O	O	O	O	O	C
CL_7	O_1	O_3	O_7	O_8	O_9	O_12	C_1
39	40	41	42	43	44	45	46

47	C_3	C	PC_3	Potato	85.68	32.77	52.91	17.22	8.72	8.50	08.02.16	5.89	3.31	1.61	1.91	24.14	98.16	103.59	1200	358.2	841.8	18.01.16	0.21	0.01	210.10	989.90	05.02.16	8.18	24.02.16
48	C_7	C	PC_7	Potato	98.43	38.55	59.88	17.16	8.08	9.08	08.02.16	5.98	4.00	1.50	2.00	32.40	134.70	172.60	1200	321.5	878.5	18.01.16	0.20	0.00	384.70	815.30	05.02.16	8.39	24.02.16
49	C_8	C	PC_8	Potato	80.02	32.65	47.37	16.19	7.44	8.75	08.02.16	5.95	3.68	1.89	1.70	29.72	106.60	144.59	1200	425	775.0	18.01.16	0.24	0.01	379.20	820.80	05.02.16	9.88	24.02.16
50	C_9	C	PC_9	Potato	78.43	32.90	45.53	14.49	6.95	7.54	08.02.16	5.69	3.69	2.42	2.04	29.47	89.20	130.40	1200	501.7	698.3	18.01.16	0.26	0.02	404.80	795.20	05.02.16	9.03	24.02.16
51	C_12	C	PC_12	Potato	91.56	53.95	37.61	19.02	12.63	6.39	08.02.16	5.86	3.52	2.01	1.91	39.63	132.36	149.66	1200	511.5	688.5	18.01.16	0.28	0.02	333.20	866.80	05.02.16	17.98	23.02.16
52	CL_10	CL	CM_10	Mix	32.13	29.26	2.87	8.62	7.81	0.81	08.02.16	5.76	4.56	3.52	0.78	19.75	27.67	104.22	1200	611	589.0	18.01.16	0.28	0.00	746.60	453.40	05.02.16	5.14	24.02.16
53	O_1	O	CO_1	Old	62.16	26.40	35.76	13.15	6.40	6.75	08.02.16	6.19	4.04	1.81	1.20	24.37	161.96	132.98	1200		1200.0	18.01.16	0.35	0.01	61.40	1138.60	05.02.16	6.08	24.02.16
54	O_3	O	CO_3	Old	82.73	25.34	57.39	18.63	6.87	11.76	08.02.16	6.00	3.92	2.61	1.20	26.98	82.44	135.49	1200	371.8	828.2	18.01.16	0.30	0.00	141.00	1059.00	05.02.16	13.74	24.02.16

23.02.16	23.02.16	23.02.16	22.02.16	23.02.16	22.02.16	22.02.16	22.02.16
11.12	9.27	11.73	12.11	13.78	14.71	11.67	10.43
05.02.16	05.02.16	06.02.16	06.02.16	06.02.16	06.02.16	06.02.16	06.02.16
1083.70	1039.40	595.20	1083.90	1117.90	841.90	1132.30	1113.00
116.30	160.60	604.80	116.10	82.10	358.10	67.70	87.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.34	0.36	0.35	0.36	0.38	0.39	0.50	0.41
18.01.16	19.01.16	19.01.16	19.01.16	19.01.16	19.01.16	19.01.16	19.01.16
881.4	921.6	974.4	1018.4	930.1	739.4	820.8	1072.6
318.6	278.4	225.6	181.6	269.9	460.6	379.2	127.4
1200	1200	1200	1200	1200	1200	1200	1200
126.52	137.57	132.98	135.49	126.52	137.57	131.58	81.53
77.95	60.90	161.96	82.44	77.95	60.90	69.00	53.85
25.34	29.64	24.37	26.98	25.34	29.64	30.89	26.07
1.61	1.11	1.20	1.20	1.61	1.11	1.00	0.70
2.41	2.33	1.81	2.61	2.41	2.33	2.31	2.31
3.68	4.52	4.04	3.92	3.68	4.52	4.76	4.16
6.10	6.03	6.19	6.00	6.10	6.03	6.00	6.13
08.02.16	08.02.16	09.02.16	09.02.16	09.02.16	09.02.16	09.02.16	09.02.16
10.97	6.44	9.31	10.69	9.29	6.27	7.26	7.64
6.15	7.49	5.71	8.43	7.11	7.85	8.89	6.04
17.12	13.93	15.02	19.12	16.4	14.12	16.15	13.68
53.01	34.04	48.60	53.98	48.63	33.18	36.91	38.32
25.79	30.42	22.89	32.37	27.37	31.35	33.08	23.31
78.80	64.46	71.49	86.35	76.00	64.53	69.99	61.63
Old	Old	No-mix	No-mix	No-mix	No-mix	No-mix	No-mix
CO_7	CO_8	CNM_1	CNM_3	CNM_7	CNM_8	CNM_9	CNM_12
O	O	O	O	O	O	O	O
O_7	O_8	O_1	O_3	O_7	O_8	O_9	O_12
55	56	57	58	59	60	61	62

63	C_1	C	CNM_1	No-mix	80.03	31.85	48.18	18.89	8.60	10.29	09.02.16	5.48	3.22	1.91	2.41	29.97	88.10	104.80	1200	216.9	983.1	19.01.16	0.44	0.01	220.80	979.20	06.02.16	11.89	22.02.16
64	C_3	C	CNM_3	No-mix	92.63	34.38	58.25	18.82	8.54	10.28	09.02.16	5.89	3.31	1.61	1.91	24.14	98.16	103.59	1200	193.2	1006.8	19.01.16	0.43	0.00	201.40	998.60	06.02.16	10.72	23.02.16
65	C_7	C	CNM_7	No-mix	95.59	35.25	60.34	20.17	8.95	11.22	09.02.16	5.98	4.00	1.50	2.00	32.40	134.70	172.60	1200	264.9	935.1	19.01.16	0.37	0.00	294.30	905.70	06.02.16	10.89	22.02.16
66	C_8	C	CNM_8	No-mix	70.44	37.71	32.73	14.51	8.91	5.60	09.02.16	5.95	3.68	1.89	1.70	29.72	106.60	144.59	1200	267.2	932.8	19.01.16	0.32	0.01	396.10	803.90	06.02.16	9.61	22.02.16
67	C_9	C	CNM_9	No-mix	83.85	39.35	44.50	17.98	10.08	7.90	09.02.16	5.69	3.69	2.42	2.04	29.47	89.20	130.40	1200	378.1	821.9	19.01.16	0.32	0.00	321.40	878.60	06.02.16	15.58	22.02.16
68	C_12	C	CNM_12	No-mix	98.04	57.00	41.04	19.91	13.14	6.77	09.02.16	5.86	3.52	2.01	1.91	39.63	132.36	149.66	1200	300.6	899.4	19.01.16	0.30	0.01	315.80	884.20	06.02.16	15.6	23.02.16
69	CL_2	CL	CM_2	Mix	39.69	38.23	1.46	10.35	10.03	0.32	09.02.16	5.65	4.23	3.30	0.90	31.60	49.50	99.40	1200	289.5	910.5	19.01.16	0.27	0.00	545.80	654.20	06.02.16	13.07	22.02.16
70	O_1	O	CM_2	Mix	63.99	25.47	38.52	14.42	6.75	7.67	09.02.16	6.19	4.04	1.81	1.20	24.37	161.96	132.98	1200	626.8	573.2	19.01.16	0.26	0.00	269.70	930.30	06.02.16	9.33	22.02.16

71	O_3	O	CM_4	Mix	78.86	32.15	46.71	17.54	8.78	8.76	09.02.16	6.00	3.92	2.61	1.20	26.98	82.44	135.49	1200	229.5	970.5	19.01.16	0.25	0.01	69.80	1130.20	06.02.16	13.12	23.02.16
72	O_7	O	CM_5	Mix	83.59	29.54	54.05	18.8	7.75	11.05	09.02.16	6.10	3.68	2.41	1.61	25.34	77.95	126.52	1200	229.1	970.9	19.01.16	0.27	0.01	78.50	1121.50	06.02.16	11.01	22.02.16
73	O_8	O	CM_6	Mix	63.62	27.76	35.86	14.56	7.53	7.03	09.02.16	6.03	4.52	2.33	1.11	29.64	60.90	137.57	1200	231.4	968.6	19.01.16	0.26	0.00	324.50	875.50	06.02.16	12.81	22.02.16
74	O_9	O	CM_10	Mix	64.48	29.34	35.14	14.77	7.74	7.03	09.02.16	6.00	4.76	2.31	1.00	30.89	69.00	131.58	1200	286.5	913.5	19.01.16	0.20	0.13	186.10	1013.90	06.02.16	11.91	22.02.16
75	O_12	O	CM_11	Mix	64.69	24.60	40.09	13.77	6.02	7.75	09.02.16	6.13	4.16	2.31	0.70	26.07	53.85	81.53	1200	123.3	1076.7	19.01.16	0.20	0.00	467.80	732.20	06.02.16	10.51	23.02.16
76	C_1	C	CM_2	Mix	93.42	37.68	55.74	18.81	9.21	9.60	09.02.16	5.48	3.22	1.91	2.41	29.97	88.10	104.80	1200	224.1	975.9	19.01.16	0.16	0.00	270.80	929.20	06.02.16	20.78	22.02.16
77	C_3	C	CM_4	Mix	89.82	31.51	58.31	18.46	7.94	10.52	09.02.16	5.89	3.31	1.61	1.91	24.14	98.16	103.59	1200	293.7	906.3	19.01.16	0.13	0.01	243.50	956.50	06.02.16	10.75	22.02.16
78	C_7	C	CM_5	Mix	97.02	42.52	54.50	17.69	9.17	8.52	09.02.16	5.98	4.00	1.50	2.00	32.40	134.70	172.60	1200	153.1	1046.9	19.01.16	0.08	0.00	395.50	804.50	06.02.16	14.85	23.02.16

79	C_8	C	CM_6	Mix	84.07	32.07	52.00	16.47	7.37	9.10	09.02.16	5.95	3.68	1.89	1.70	29.72	106.60	144.59	1200	130.4	1069.6	19.01.16	0.01	0.00	336.80	863.20	06.02.16	12.56	22.02.16
80	C_9	C	CM_10	Mix	83.57	31.66	51.91	19.12	8.44	10.68	09.02.16	5.69	3.69	2.42	2.04	29.47	89.20	130.40	1200	302.8	897.2	19.01.16	0.01	0.01	300.40	899.60	06.02.16	11.93	22.02.16
81	C_12	C	CM_11	Mix	101.26	62.07	39.19	21.75	15.52	6.23	09.02.16	5.86	3.52	2.01	1.91	39.63	132.36	149.66	1200	280.6	919.4	19.01.16	0.07	0.00	385.00	815.00	06.02.16	11.54	23.02.16
82	CL_5	CL	CM_5	Mix	35.76	30.41	5.35	9.14	7.83	1.31	09.02.16	6.04	4.36	12.84	0.70	1.91	46.03	124.36	1200	169.6	1030.4	19.01.16	0.01	0.00	816.50	383.50	06.02.16	8.13	22.02.16
83	O_1	O	CS_1	Sterile	74.21	26.45	47.76	16.22	6.71	9.51	09.02.16	6.19	4.04	1.81	1.20	24.37	161.96	132.98	1200	210.2	989.8	19.01.16	0.01	0.00	100.40	1099.60	06.02.16	11.34	22.02.16
84	O_3	O	CS_3	Sterile	87.36	37.05	50.31	20.13	9.97	10.16	09.02.16	6.00	3.92	2.61	1.20	26.98	82.44	135.49	1200	125.6	1074.4	19.01.16	0.03	0.00	65.20	1134.80	06.02.16	12.03	22.02.16
85	O_7	O	CS_7	Sterile	79.23	30.63	48.60	17.34	7.90	9.44	09.02.16	6.10	3.68	2.41	1.61	25.34	77.95	126.52	1200	212.8	987.2	19.01.16	0.02	0.00	87.00	1113.00	06.02.16	12.98	22.02.16
86	O_8	O	CS_8	Sterile	65.28	35.67	29.61	15.07	9.35	5.72	09.02.16	6.03	4.52	2.33	1.11	29.64	60.90	137.57	1200	312.6	887.4	21.01.16	0.11	0.00	146.20	1053.80	06.02.16	10.36	22.02.16

87	O_9	O	CS_9	Sterile	63.93	30.28	33.65	15.32	8.37	6.95	09.02.16	6.00	4.76	2.31	1.00	30.89	69.00	131.58	1200	154.2	1045.8	21.01.16	0.00	0.00	97.00	1103.00	06.02.16	10.29	22.02.16
88	O_12	O	CS_12	Sterile	64.51	25.45	39.06	13.71	6.49	7.22	09.02.16	6.13	4.16	2.31	0.70	26.07	53.85	81.53	1200	242.1	957.9	21.01.16	0.03	0.00	513.40	686.60	06.02.16	8.53	22.02.16
89	C_1	C	CS_1	Sterile	91.77	38.24	53.53	19.53	10.02	9.51	09.02.16	5.48	3.22	1.91	2.41	29.97	88.10	104.80	1200	154.8	1045.2	21.01.16	0.03	0.00	185.70	1014.30	06.02.16	14.24	22.02.16
90	C_3	C	CS_3	Sterile	97.75	37.09	60.66	19.74	8.71	11.03	09.02.16	5.89	3.31	1.61	1.91	24.14	98.16	103.59	1200	143.2	1056.8	21.01.16	0.07	0.01	181.80	1018.20	06.02.16	12.82	22.02.16
91	C_7	C	CS_7	Sterile	100.18	40.10	60.08	20.04	9.42	10.62	09.02.16	5.98	4.00	1.50	2.00	32.40	134.70	172.60	1200	371.4	828.6	21.01.16	0.10	0.01	314.60	885.40	06.02.16	11.65	23.02.16
92	C_8	C	CS_8	Sterile	88.12	33.11	55.01	18.04	7.76	10.28	09.02.16	5.95	3.68	1.89	1.70	29.72	106.60	144.59	1200	350.4	849.6	21.01.16	0.06	0.01	399.70	800.30	06.02.16	9.97	22.02.16
93	C_9	C	CS_9	Sterile	85.94	36.05	49.89	18.18	8.71	9.47	09.02.16	5.69	3.69	2.42	2.04	29.47	89.20	130.40	1200	501.5	698.5	21.01.16	0.02	0.00	408.30	791.70	06.02.16	14.09	22.02.16
94	C_12	C	CS_12	Sterile	98.06	59.10	38.96	21.09	14.64	6.45	09.02.16	5.86	3.52	2.01	1.91	39.63	132.36	149.66	1200	192.1	1007.9	21.01.16	0.01	0.00	395.80	804.20	06.02.16	15.12	23.02.16

95	CL_8	CL	CNM_8	No-mix	31.35	28.12	3.23	8.39	7.48	0.91	09.02.16	5.59	4.25	2.89	0.80	31.21	22.14	88.05	1200	234.7	965.3	21.01.16	0.05	0.10	828.20	371.80	06.02.16	5.51	22.02.16
96	O_1	O	PO_1	Potato	59.91	23.37	36.54	12.96	6.12	6.84	09.02.16	6.19	4.04	1.81	1.20	24.37	161.96	132.98	1200	211.3	988.7	21.01.16	0.10	0.00	587.10	612.90	06.02.16	11.79	22.02.16
97	O_3	O	PO_3	Potato	81.37	30.00	51.37	18.91	8.21	10.70	09.02.16	6.00	3.92	2.61	1.20	26.98	82.44	135.49	1200	310.1	889.9	21.01.16	0.09	0.00	116.30	1083.70	06.02.16	14.14	22.02.16
98	O_7	O	PO_7	Potato	84.94	27.72	57.22	19.59	7.54	12.05	09.02.16	6.10	3.68	2.41	1.61	25.34	77.95	126.52	1200	100.2	1099.8	21.01.16	0.12	0.00	75.50	1124.50	06.02.16	15.9	22.02.16
99	O_8	O	PO_8	Potato	74.08	28.42	45.66	16.8	7.90	8.90	09.02.16	6.03	4.52	2.33	1.11	29.64	60.90	137.57	1200	172.1	1027.9	21.01.16	0.23	0.00	175.90	1024.10	06.02.16	7.2	23.02.16
100	O_9	O	PO_9	Potato	67.97	30.33	37.64	15.5	8.25	7.25	09.02.16	6.00	4.76	2.31	1.00	30.89	69.00	131.58	1200	238.5	961.5	21.01.16	0.08	0.00	178.90	1021.10	06.02.16	11.26	22.02.16
101	O_12	O	PO_12	Potato	75.22	22.64	52.58	16.95	6.44	10.51	09.02.16	6.13	4.16	2.31	0.70	26.07	53.85	81.53	1200	238.1	961.9	21.01.16	0.03	0.00	154.30	1045.70	06.02.16	11.15	22.02.16
102	C_1	C	PC_1	Potato	94.56	36.59	57.97	18.94	8.96	9.98	09.02.16	5.48	3.22	1.91	2.41	29.97	88.10	104.80	1200	184.1	1015.9	21.01.16	0.02	0.00	210.50	989.50	06.02.16	10.42	22.02.16

22.02.16	22.02.16	22.02.16	23.02.16	22.02.16	22.02.16	22.02.16	23.02.16
14.58	15.73	9.34	12.08	16.53	7.96	11.47	12.81
06.02.16	06.02.16	06.02.16	06.02.16	06.02.16	06.02.16	06.02.16	06.02.16
1045.20	871.60	904.50	804.40	840.10	450.10	640.10	1071.90
154.80	328.40	295.50	395.60	359.90	749.90	559.90	128.10
0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00
0.03	0.03	0.04	0.02	0.02	0.01	0.07	0.03
21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16
936.9	820.4	898.8	868.1	1011.5	961.5	977.9	810.3
263.1	379.6	301.2	331.9	188.5	238.5	222.1	389.7
1200	1200	1200	1200	1200	1200	1200	1200
103.59	172.60	144.59	130.40	149.66	115.80	132.98	135.49
98.16	134.70	106.60	89.20	132.36	31.20	161.96	82.44
24.14	32.40	29.72	29.47	39.63	31.10	24.37	26.98
1.91	2.00	1.70	2.04	1.91	0.80	1.20	1.20
1.61	1.50	1.89	2.42	2.01	3.00	1.81	2.61
3.31	4.00	3.68	3.69	3.52	4.48	4.04	3.92
5.89	5.98	5.95	5.69	5.86	5.92	6.19	6.00
09.02.16	09.02.16	09.02.16	09.02.16	09.02.16	09.02.16	09.02.16	09.02.16
10.92	12.71	9.98	8.51	5.24	1.01	9.45	9.52
7.98	8.16	7.84	9.47	15.18	8.63	6.03	9.69
18.9	20.87	17.82	17.98	20.42	9.64	15.48	19.21
59.74	69.39	60.57	51.96	32.79	3.64	47.49	48.37
32.87	37.16	35.65	38.88	62.12	33.76	24.33	35.80
92.61	106.55	96.22	90.84	94.91	37.40	71.82	84.17
Potato	Potato	Potato	Potato	Potato	Mix	Old	Old
PC_3	PC_7	PC_8	PC_9	PC_12	CM_11	CO_1	CO_3
C	C	C	C	C	CL	O	O
C_3	C_7	C_8	C_9	C_12	CL_11	O_1	O_3
103	104	105	106	107	108	109	110

111	O_7	O	CO_7	Old	77.89	29.14	48.75	16.38	7.45	8.93	09.02.16	6.10	3.68	2.41	1.61	25.34	77.95	126.52	1200	351.4	848.6	21.01.16	0.04	0.00	114.80	1085.20	06.02.16	10.3	23.02.16
112	O_8	O	CO_8	Old	70.66	29.87	40.79	16.37	8.37	8.00	09.02.16	6.03	4.52	2.33	1.11	29.64	60.90	137.57	1200	569.7	630.3	21.01.16	0.03	0.00	80.30	1119.70	06.02.16	12.13	22.02.16
113	O_1	O	CNM_1	No-mix	75.79	25.15	50.64	17.06	6.83	10.23	10.02.16	6.19	4.04	1.81	1.20	24.37	161.96	132.98	1200		1200.0	21.01.16	0.06	0.00	420.40	779.60	06.02.16	7.89	08.03.16
114	O_3	O	CNM_3	No-mix	83.86	33.53	50.33	19.14	8.95	10.19	10.02.16	6.00	3.92	2.61	1.20	26.98	82.44	135.49	1200	207.2	992.8	21.01.16	0.02	0.00	159.60	1040.40	06.02.16	9.35	09.03.16
115	O_7	O	CNM_7	No-mix	86.35	35.10	51.25	18.15	8.81	9.34	10.02.16	6.10	3.68	2.41	1.61	25.34	77.95	126.52	1200	209.4	990.6	21.01.16	0.01	0.00	86.20	1113.80	06.02.16	10.22	08.03.16
116	O_8	O	CNM_8	No-mix	67.41	34.64	32.77	15.66	9.22	6.44	10.02.16	6.03	4.52	2.33	1.11	29.64	60.90	137.57	1200	147.7	1052.3	21.01.16	0.01	0.00	497.00	703.00	06.02.16	7.08	09.03.16
117	O_9	O	CNM_9	No-mix	78.59	28.47	50.12	16.57	7.09	9.48	10.02.16	6.00	4.76	2.31	1.00	30.89	69.00	131.58	1200	185.2	1014.8	21.01.16	0.03	0.00	327.10	872.90	06.02.16	7.69	09.03.16
118	O_12	O	CNM_12	No-mix	62.56	26.58	35.98	14.19	7.10	7.09	10.02.16	6.13	4.16	2.31	0.70	26.07	53.85	81.53	1200	178.9	1021.1	21.01.16	0.02	0.00	296.20	903.80	06.02.16	6.71	09.03.16

119	C_1	C	CNM_1	No-mix	93.36	37.98	55.38	19.59	9.28	10.31	10.02.16	5.48	3.22	1.91	2.41	29.97	88.10	104.80	1200	351.9	848.1	21.01.16	0.07	0.00	334.30	865.70	06.02.16	12.53	09.03.16
120	C_3	C	CNM_3	No-mix	95.44	32.92	62.52	20.51	8.31	12.20	10.02.16	5.89	3.31	1.61	1.91	24.14	98.16	103.59	1200	143.4	1056.6	21.01.16	0.01	0.00	218.80	981.20	06.02.16	13.06	09.03.16
121	C_7	C	CNM_7	No-mix	99.83	37.43	62.40	20.22	8.58	11.64	10.02.16	5.98	4.00	1.50	2.00	32.40	134.70	172.60	1200	362.8	837.2	21.01.16	0.02	0.01	405	795	06.02.16	9.98	09.03.16
122	C_8	C	CNM_8	No-mix	98.35	34.67	63.68	19.26	7.97	11.29	10.02.16	5.95	3.68	1.89	1.70	29.72	106.60	144.59	1200	324.1	875.9	21.01.16	0.28	2.37	336.3	863.7	06.02.16	14.18	09.03.16
123	C_9	C	CNM_9	No-mix	84.41	35.10	49.31	17.69	8.98	8.71	10.02.16	5.69	3.69	2.42	2.04	29.47	89.20	130.40	1200	318.5	881.5	21.01.16	0.01	0.02	191.9	1008.1	06.02.16	9.55	09.03.16
124	C_12	C	CNM_12	No-mix	99.67	51.54	48.13	21.62	13.26	8.36	10.02.16	5.86	3.52	2.01	1.91	39.63	132.36	149.66	1200	407.5	792.5	21.01.16	0.00	0.01	376.2	823.8	06.02.16	9.91	08.03.16
125	CL_3	CL	CNM_3	No-mix	45.57	33.50	12.07	12.09	9.51	2.58	10.02.16	5.59	4.34	2.31	0.80	24.34	35.70	109.93	1200	717.5	482.5	21.01.16	0.00	0.00	804.20	395.80	06.02.16	5.17	09.03.16
126	O_1	O	CM_2	Mix	68.23	24.17	44.06	14.7	6.05	8.65	10.02.16	6.19	4.04	1.81	1.20	24.37	161.96	132.98	1200	134.9	1065.1	21.01.16	0.00	0.00	586.30	613.70	06.02.16	6.41	08.03.16

09.03.16	09.03.16	08.03.16	09.03.16	08.03.16	09.03.16	09.03.16	09.03.16
11.03	16.32	6.88	7.19	5.55	11.62	9.38	12.45
06.02.16	06.02.16	06.02.16	06.02.16	06.02.16	06.02.16	06.02.16	06.02.16
1075.70	976.50	960.80	804.00	676.20	916.80	946.90	794.90
124.30	223.50	239.20	396.00	523.80	283.20	253.10	405.10
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
0.00	0.03	0.00	0.03	0.00	0.00	0.00	0.04
21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16
1051.5	1037.5	1012.7	1040.9	1001.6	884.4	1025.7	857.8
148.5	162.5	187.3	159.1	198.4	315.6	174.3	342.2
1200	1200	1200	1200	1200	1200	1200	1200
135.49	126.52	137.57	131.58	81.53	104.80	103.59	172.60
82.44	77.95	60.90	69.00	53.85	88.10	98.16	134.70
26.98	25.34	29.64	30.89	26.07	29.97	24.14	32.40
1.20	1.61	1.11	1.00	0.70	2.41	1.91	2.00
2.61	2.41	2.33	2.31	2.31	1.91	1.61	1.50
3.92	3.68	4.52	4.76	4.16	3.22	3.31	4.00
6.00	6.10	6.03	6.00	6.13	5.48	5.89	5.98
10.02.16	10.02.16	10.02.16	10.02.16	10.02.16	10.02.16	10.02.16	10.02.16
10.12	10.45	7.87	7.74	6.45	11.08	9.95	12.73
7.92	8.02	8.33	8.32	7.42	8.01	7.16	9.90
18.04	18.47	16.2	16.06	13.87	19.09	17.11	22.63
51.74	54.19	39.33	42.04	33.13	60.05	56.29	63.45
30.92	32.20	30.55	32.80	27.07	35.24	33.03	40.92
82.66	86.39	69.88	74.84	60.20	95.29	89.32	104.37
Mix	Mix	Mix	Mix	Mix	Mix	Mix	Mix
CM_4	CM_5	CM_6	CM_10	CM_11	CM_2	CM_4	CM_5
O	O	O	O	O	C	C	C
O_3	O_7	O_8	O_9	O_12	C_1	C_3	C_7
127	128	129	130	131	132	133	134

08.03.16	08.03.16	09.03.16	09.03.16	08.03.16	08.03.16	08.03.16	09.03.16
9.84	8.71	12.23	4.45	6.24	7.99	9.48	6.71
06.02.16	06.02.16	06.02.16	06.02.16	06.02.16	06.02.16	06.02.16	06.02.16
799.30	881.30	828.30	2.40	835.00	1004.70	1041.30	885.60
400.70	318.70	371.70	1197.60	365.00	195.30	158.70	314.40
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.02	0.00	0.01	0.02
21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16
895.1	934.0	954.5	270.7	1097.2	1024.7	1014.8	984.8
304.9	266	245.5	929.3	102.8	175.3	185.2	215.2
1200	1200	1200	1200	1200	1200	1200	1200
144.59	130.40	149.66		132.98	135.49	126.52	137.57
106.60	89.20	132.36		161.96	82.44	77.95	60.90
29.72	29.47	39.63		24.37	26.98	25.34	29.64
1.70	2.04	1.91		1.20	1.20	1.61	1.11
1.89	2.42	2.01		1.81	2.61	2.41	2.33
3.68	3.69	3.52		4.04	3.92	3.68	4.52
5.95	5.69	5.86		6.19	6.00	6.10	6.03
10.02.16	10.02.16	10.02.16	10.02.16	10.02.16	10.02.16	10.02.16	10.02.16
10.96	10.62	5.03	0.87	8.62	9.04	11.81	7.31
8.19	9.19	15.36	4.74	6.09	9.59	8.16	8.38
19.15	19.81	20.39	5.61	14.71	18.63	19.97	15.69
60.31	56.44	30.16	4.20	45.05	49.91	59.29	35.92
33.65	35.54	60.82	23.20	23.50	37.90	31.84	30.27
93.96	91.98	90.98	27.40	68.55	87.81	91.13	66.19
Mix	Mix	Mix	Mix	Sterile	Sterile	Sterile	Sterile
CM_6	CM_10	CM_11	CM_6	CS_1	CS_3	CS_7	CS_8
C	C	C	CL	O	O	O	O
C_8	C_9	C_12	CL_6	O_1	O_3	O_7	O_8
135	136	137	138	139	140	141	142

143	O_9	O	CS_9	Sterile	81.86	29.28	52.58	17.36	7.51	9.85	10.02.16	6.00	4.76	2.31	1.00	30.89	69.00	131.58	1200	168.8	1031.2	21.01.16	0.01	0.00	177.00	1023.00	06.02.16	7.16	08.03.16
144	O_12	O	CS_12	Sterile	60.43	29.62	30.81	14	7.92	6.08	10.02.16	6.13	4.16	2.31	0.70	26.07	53.85	81.53	1200	208.7	991.3	21.01.16	0.02	0.00	673.10	526.90	06.02.16	6.51	09.03.16
145	C_1	C	CS_1	Sterile	93.76	34.96	58.80	19.26	8.48	10.78	10.02.16	5.48	3.22	1.91	2.41	29.97	88.10	104.80	1200	206.3	993.7	21.01.16	0.02	0.00	316.70	883.30	06.02.16	11.82	09.03.16
146	C_3	C	CS_3	Sterile	93.71	33.33	60.38	22.21	9.23	12.98	10.02.16	5.89	3.31	1.61	1.91	24.14	98.16	103.59	1200	150	1050.0	21.01.16	0.02	0.00	123.70	1076.30	06.02.16	11.46	08.03.16
147	C_7	C	CS_7	Sterile	110.37	44.02	66.35	21.28	9.87	11.41	10.02.16	5.98	4.00	1.50	2.00	32.40	134.70	172.60	1200	338.9	861.1	21.01.16	0.05	0.00	424.60	775.40	06.02.16	10.78	08.03.16
148	C_8	C	CS_8	Sterile	95.49	34.49	61.00	19.96	8.02	11.94	10.02.16	5.95	3.68	1.89	1.70	29.72	106.60	144.59	1200	275.6	924.4	21.01.16	0.04	0.00	359.70	840.30	06.02.16	12.16	09.03.16
149	C_9	C	CS_9	Sterile	85.78	34.62	51.16	18.04	8.44	9.60	10.02.16	5.69	3.69	2.42	2.04	29.47	89.20	130.40	1200	291.1	908.9	21.01.16	0.03	0.00	343.60	856.40	06.02.16	8.66	08.03.16
150	C_12	C	CS_12	Sterile	99.76	58.05	41.71	23.47	15.88	7.59	10.02.16	5.86	3.52	2.01	1.91	39.63	132.36	149.66	1200	326.9	873.1	21.01.16	0.04	0.00	311.50	888.50	06.02.16	14.61	08.03.16

08.03.16	09.03.16	08.03.16	09.03.16	09.03.16	09.03.16	08.03.16	09.03.16
4.97	7.31	8.84	12.38	6.32	8.93	6.58	9.98
06.02.16	06.02.16	06.02.16	06.02.16	06.02.16	06.02.16	06.02.16	06.02.16
368.40	803.90	1096.80	995.60	735.70	1105.30	693.30	842.90
831.60	396.10	103.20	204.40	464.30	94.70	506.70	357.10
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.04	0.07	0.05	0.05	0.24	0.04	0.07	0.04
21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16
603.7	1078.5	1014.2	1029.3	915.9	995.7	1061.6	937.4
596.3	121.5	185.8	170.7	284.1	204.3	138.4	262.6
1200	1200	1200	1200	1200	1200	1200	1200
94.74	132.98	135.49	126.52	137.57	131.58	81.53	104.80
32.59	161.96	82.44	77.95	60.90	69.00	53.85	88.10
33.59	24.37	26.98	25.34	29.64	30.89	26.07	29.97
0.70	1.20	1.20	1.61	1.11	1.00	0.70	2.41
3.72	1.81	2.61	2.41	2.33	2.31	2.31	1.91
4.58	4.04	3.92	3.68	4.52	4.76	4.16	3.22
5.53	6.19	6.00	6.10	6.03	6.00	6.13	5.48
10.02.16	10.02.16	10.02.16	10.02.16	10.02.16	10.02.16	10.02.16	10.02.16
0.88	8.73	10.36	11.14	7.53	11.42	8.68	10.04
8.47	6.30	9.05	8.85	8.43	7.36	6.60	10.29
9.35	15.03	19.41	19.99	15.96	18.78	15.28	20.33
3.11	44.34	53.49	55.73	40.54	58.68	44.64	54.35
31.75	23.88	35.13	33.96	32.51	48.65	25.05	41.91
34.86	68.22	88.62	89.69	73.05	107.33	69.69	96.26
No-mix	Potato	Potato	Potato	Potato	Potato	Potato	Potato
CNM_9	PO_1	PO_3	PO_7	PO_8	PO_9	PO_12	PC_1
CL	O	O	O	O	O	O	C
CL_9	O_1	O_3	O_7	O_8	O_9	O_12	C_1
151	152	153	154	155	156	157	158

09.03.16	08.03.16	09.03.16	08.03.16	08.03.16	09.03.16	08.03.16	09.03.16
9.61	13.74	12.94	10.11	8.92	5.5	9.88	7.74
06.02.16	06.02.16	06.02.16	06.02.16	06.02.16	06.02.16	06.02.16	06.02.16
993.90	755.90	878.20	867.80	825.70	595.80	942.40	793.00
206.10	444.10	321.80	332.20	374.30	604.20	257.60	407.00
0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
0.05	0.06	0.07	0.05	0.05	0.07	0.05	0.08
21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16
1007.4	848.7	867.4	943.9	903.1	690.9	996.3	1028.8
192.6	351.3	332.6	256.1	296.9	509.1	203.7	171.2
1200	1200	1200	1200	1200	1200	1200	1200
103.59	172.60	144.59	130.40	149.66	106.81	131.58	81.53
98.16	134.70	106.60	89.20	132.36	25.24	69.00	53.85
24.14	32.40	29.72	29.47	39.63	31.98	30.89	26.07
1.91	2.00	1.70	2.04	1.91	0.70	1.00	0.70
1.61	1.50	1.89	2.42	2.01	3.32	2.31	2.31
3.31	4.00	3.68	3.69	3.52	4.54	4.76	4.16
5.89	5.98	5.95	5.69	5.86	5.67	6.00	6.13
10.02.16	10.02.16	10.02.16	10.02.16	10.02.16	10.02.16	10.02.16	10.02.16
10.76	10.70	10.81	11.29	7.68	0.63	9.72	9.21
8.21	9.58	8.64	8.03	14.01	8.71	7.47	6.00
18.97	20.28	19.45	19.32	21.69	9.34	17.19	15.21
60.81	55.61	57.00	58.92	42.98	2.23	47.17	46.94
33.45	39.28	36	33.91	52.49	33.61	28.18	22.46
94.26	94.89	93.00	92.83	95.47	35.84	75.35	69.40
Potato	Potato	Potato	Potato	Potato	No-mix	Old	Old
PC_3	PC_7	PC_8	PC_9	PC_12	CNM_12	CO_9	CO_12
C	C	C	C	C	CL	O	O
C_3	C_7	C_8	C_9	C_12	CL_12	O_9	O_12
159	160	161	162	163	164	165	166

167	O_9	O	CO_9	Old	73.61	31.32	42.29	15.87	7.83	8.04	10.02.16	6.00	4.76	2.31	1.00	30.89	69.00	131.58	1200	240.5	959.5	21.01.16	0.07	0.00	264.50	935.50	06.02.16	7.62	08.03.16
168	O_12	O	CO_12	Old	68.05	22.37	45.68	15.15	5.95	9.20	10.02.16	6.13	4.16	2.31	0.70	26.07	53.85	81.53	1200	161.2	1038.8	21.01.16	0.07	0.00	541.50	658.50	06.02.16	7.46	09.03.16

Appendix 14 – Part 2 of 2 of the table containing all collected data from current experiment. Pot 1-56 were placed in block 1 of experiment, 57-112 in block 2 and 113-168 were place in block 3.

	Recipient soil and inoculum							Water holding capacity			Monitoring soil moisture (every 2 weeks)							Soil vol. end		Crop NPK							Nutrients inoculum (donor soil)				
Pot Nr.	Soil (g)	Inoculum (g)	Inoculum (ml)	Moisture content (init.)	Dry weight	Per pot (g)	Pot soil dry (g)	WHC 100%	WHC 60%	Pot weight WHC 60% (g)	Pot W2 (g)	Pot W4 (g)	Pot W6 (g)	Pot W8 (g)	Pot W10 (g)	Pot W12 (g)	Weight after harvest	Soil surface (cm below)	Soil vol. (L)	Sample (g)	ppm N	Percent. N	ppm P	Percent P	ppm K	Percent K	Inoc.N.NH4	Inoc.P.PO4	Inoc.N.NO3	Inoc.K	Inoc.Mg
1	3438	84	75	12%	3025.44	100	3109.44	30.0%	18.0%	3654.02	3658	3514	3550	4512	4312	3953.5	3953.5	5.0	3.138								2.41	1	26.88	29.38	119.8
2	3387	84	75	14%	2912.82	100	2996.82	30.0%	18.0%	3521.13	3535	3418	3470	4234	3968	3827.4	3827.4	5.8	2.945								2.31	0.8	24.34	35.7	109.9
3	3484	88	75	13%	3031.08	100	3119.08	29.8%	17.9%	3661.04	3662	3519	3527	4195	3942	4369.6	4369.6	4.9	3.162												
4	3259	87	75	16%	2737.56	100	2824.56	32.8%	19.7%	3363.31	3455	3379	3292	3984	3769	3813.9	3813.9	5.1	3.114								2.89	0.8	31.21	22.14	88
5	3676	84	75	15%	3124.60	100	3208.60	31.8%	19.1%	3804.77	3807	3624	3575	4316	4083	4209.8	4209.8	4.9	3.162								3.72	0.7	33.59	32.59	94.7
6	3556	86	75	16%	2987.04	100	3073.04	32.4%	19.4%	3653.72	3709	3617	3649	4320	4042	4143.6	4143.6	4.5	3.259								3.32	0.7	31.98	25.24	106.8

119.8	109.9		88	94.7	106.8	119.8	99.4
29.38	35.7		22.14	32.59	25.24	29.38	49.5
26.88	24.34		31.21	33.59	31.98	26.88	31.6
1	0.8		0.8	0.7	0.7	1	0.9
2.41	2.31		2.89	3.72	3.32	2.41	3.3
3.210	3.235	3.162	3.186	3.090	3.066	3.283	3.210
4.7	4.6	4.9	4.8	5.2	5.3	4.4	4.7
3924.1	3821.3	4359.6	3896.6	3743.6	3721.5	4759.3	4054.9
3924.1	3821.3	4359.6	3896.6	3743.6	3721.5	4759.3	4054.9
3890	3909	4030	4097	3931	4221	4469	4348
4076	4037	4093	4145	3947	4064	4553	4527
3520	3586	3787	3879	3648	3710	3908	3612
3562	3562	3745	3787	3686	3752	4071	3578
3724	3664	3880	3922	3798	3874	4193	3706
3724.62	3605.68	3833.91	3601.57	3750.95	3751.52	4178.00	3706.02
17.5%	16.4%	19.1%	18.1%	18.2%	17.4%	0.0%	18.0%
29.1%	27.3%	31.9%	30.1%	30.4%	29.0%		30.0%
3183.16	3110.30	3231.48	3063.48	3185.28	3207.80	4178.00	3153.20
100	100	100	100	100	100	100	100
3101.16	3024.30	3147.48	2979.48	3101.28	3124.80	4098.00	3071.20
14%	15%	16%	16%	16%	16%		12%
75	75	75	75	75	75	75	75
82	86	84	84	84	83	80	82
3606	3558	3747	3547	3692	3720	4098	3490
7	8	9	10	11	12	13	14

15	3432	87	75	14%	2951.52	100	3038.52	30.0%	18.0%	3569.79	3575	3439	3434	4114	3854	3778.5	3778.5	5.2	3.090								12.44	0.6	2.41	39.01	137.7
16	3410	83	75	13%	2966.70	100	3049.70	29.8%	17.9%	3580.15	3582	3423	3361	3946	3826	4143.1	4143.1	5.6	2.993								12.84	0.7	1.91	46.03	124.4
17	3459	83	75	16%	2905.56	100	2988.56	32.8%	19.7%	3560.37	3656	3531	3555	4013	3813	3945.7	3945.7	4.4	3.283												
18	3364	93	75	15%	2859.40	100	2952.40	31.8%	19.1%	3497.97	3624	3517	3555	4274	3906	4085.7	4085.7	4.8	3.186								3.52	0.78	19.75	27.67	104.2
19	3385	86	75	16%	2843.40	100	2929.40	32.4%	19.4%	3482.16	3576	3436	3528	4162	3851	4083.1	4083.1	4.9	3.162								3	0.8	31.1	31.2	115.8
20	3557	90	75	14%	3059.02	100	3149.02	29.1%	17.5%	3683.12	3760	3592	3672	4246	4140	3824.6	3824.6	4.6	3.235								3.3	0.9	31.6	49.5	99.4
21	3472	84	75	15%	2951.20	100	3035.20	27.3%	16.4%	3518.61	3566	3449	3490	4094	3879	3694.9	3694.9	5.2	3.090								12.44	0.6	2.41	39.01	137.7
22	3467	87	75	16%	2912.28	100	2999.28	31.9%	19.1%	3556.69	3578	3465	3516	3870	3887	3532.8	3532.8	5.4	3.041								12.84	0.7	1.91	46.03	124.4

	104.2		137.7	119.8	109.9		88
	27.67		39.01	29.38	35.7		22.14
	19.75		2.41	26.88	24.34		31.21
	0.78		0.6	1	0.8		0.8
	3.52		12.44	2.41	2.31		2.89
3.090	3.307	3.041	3.017	3.162	3.162	3.235	3.162
5.2	4.3	5.4	5.5	4.9	4.9	4.6	4.9
3504.7	3837.5	3517.2	5037.7	4018.3	3869.2	4002.4	4117.5
3504.7	3837.5	3517.2	5037.7	4018.3	3869.2	4002.4	4117.5
3931	3995	3851	4754	4367	3876	3915	3840
3973	4106	3801	5169	4519	4081	4229	4121
3516	3714	3378	5030	3608	3504	3521	3490
3513	3700	3399	5022	3535	3477	3499	3500
3600	3866	3530	5120	3664	3623	3626	3633
3569.86	3646.67	3442.92	5291.00	3642.21	3618.47	3615.84	3489.95
18.1%	18.2%	17.4%	0.0%	18.0%	18.0%	17.9%	19.7%
30.1%	30.4%	29.0%		30.0%	30.0%	29.8%	32.8%
3037.08	3097.08	2945.68	5291.00	3100.96	3080.08	3081.19	2931.20
100	100	100	100	100	100	100	100
2950.08	3013.08	2857.68	5203.00	3006.96	2991.08	2990.19	2839.20
16%	16%	16%		12%	14%	13%	16%
75	75	75	75	75	75	75	75
87	84	88	88	94	89	91	92
3512	3587	3402	5203	3417	3478	3437	3380
23	24	25	26	27	28	29	30

31	3423	89	75	15%	2909.55	100	2998.55	31.8%	19.1%	3553.69	3711	3579	3569	4289	4119	4048.7	4048.7	5.1	3.114								3.72	0.7	33.59	32.59	94.7
32	3485	94	75	16%	2927.40	100	3021.40	32.4%	19.4%	3590.49	3655	3561	3530	4492	4321	4034.8	4034.8	5.2	3.090								3.32	0.7	31.98	25.24	106.8
33	3445	90	75	14%	2962.70	100	3052.70	29.1%	17.5%	3569.99	3607	3478	3487	4093	3784	3702.0	3702.0	5.2	3.090								2.41	1	26.88	29.38	119.8
34	3392	89	75	15%	2883.20	100	2972.20	27.3%	16.4%	3444.47	3550	3409	3425	4129	3834	3552.6	3552.6	5.2	3.090								2.31	0.8	24.34	35.7	109.9
35	3415	87	75	16%	2868.60	100	2955.60	31.9%	19.1%	3504.65	3542	3450	3506	4024	3863	3427.5	3427.5	5.4	3.041												
36	3745	86	75	16%	3145.80	100	3231.80	30.1%	18.1%	3799.93	3880	3748	3766	4107	4129	3925.8	3925.8	4.7	3.210								2.89	0.8	31.21	22.14	88
37	3446	90	75	16%	2894.64	100	2984.64	30.4%	18.2%	3512.62	3632	3514	3524	3871	3902	3568.4	3568.4	5.4	3.041								3.72	0.7	33.59	32.59	94.7
38	3359	84	75	16%	2821.56	100	2905.56	29.0%	17.4%	3396.51	3525	3402	3379	3714	3797	3486.4	3486.4	5.7	2.969								3.32	0.7	31.98	25.24	106.8

	133	135.5	126.5	137.6	131.6	81.5	104.8
	161.96	82.44	77.95	60.9	69	53.85	88.1
	24.37	26.98	25.34	29.64	30.89	26.07	29.97
	1.2	1.2	1.61	1.11	1	0.7	2.41
	1.81	2.61	2.41	2.33	2.31	2.31	1.91
3.283	3.235	3.162	3.162	3.186	3.210	3.162	3.090
4.4	4.6	4.9	4.9	4.8	4.7	4.9	5.2
4661.8	4195.7	4343.9	3942.4	4045.9	4167.8	4000.9	3761.1
4661.8	4195.7	4343.9	3942.4	4045.9	4167.8	4000.9	3761.1
4655	4281	4022	4189	3892	3959	4447	3889
4849	4467	4255	4391	4069	4223	4571	3889
4146	3730	3576	3608	3504	3499	3672	3549
4265	3713	3584	3611	3511	3546	3620	3535
4416	3815	3690	3761	3622	3688	3735	3673
4321.00	3792.13	3693.61	3754.54	3564.41	3578.06	3673.77	3666.96
0.0%	18.0%	18.0%	17.9%	19.7%	19.1%	19.4%	17.5%
	30.0%	30.0%	29.8%	32.8%	31.8%	32.4%	29.1%
4321.00	3226.48	3143.30	3197.34	2991.60	3018.05	3090.80	3135.26
100	100	100	100	100	100	100	100
4235.00	3142.48	3057.30	3116.34	2910.60	2935.05	2998.80	3045.26
	12%	14%	13%	16%	15%	16%	14%
75	75	75	75	75	75	75	75
86	84	86	81	81	83	92	90
4235	3571	3555	3582	3465	3453	3570	3541
39	40	41	42	43	44	45	46

47	3705	92	75	15%	3149.25	100	3241.25	27.3%	16.4%	3757.10	3844	3700	3692	4202	4102	4032.8	4032.8	4.8	3.186								1.61	1.91	24.14	98.16	103.6
48	3446	83	75	16%	2894.64	100	2977.64	31.9%	19.1%	3531.67	3623	3490	3487	3806	3816	3605.7	3605.7	5.3	3.066								1.5	2	32.4	134.7	172.6
49	3438	88	75	16%	2887.92	100	2975.92	30.1%	18.1%	3497.48	3600	3502	3461	3994	3896	3454.0	3454.0	5.6	2.993								1.89	1.7	29.72	106.6	144.6
50	3636	84	75	16%	3054.24	100	3138.24	30.4%	18.2%	3695.33	3757	3678	3617	4012	3887	3767.5	3767.5	4.8	3.186								2.01	1.91	39.63	132.36	149.7
51	3483	84	75	16%	2925.72	100	3009.72	29.0%	17.4%	3518.80	3595	3500	3534	3929	3881	3490.7	3490.7	5.4	3.041								2.42	2.04	29.47	89.2	130.4
52	4398	92	75		4398.00	100	4490.00		0.0%	4490.00	4624	4420	4277	4908	4746	4825.9	4825.9	4.0	3.379								3.52	0.78	19.75	27.67	104.2
53	3598	88	75	12%	3166.24	100	3254.24	30.0%	18.0%	3824.16	3824	3732	3795	4519	4184	4212.3	4212.3	4.2	3.331												
54	3516	86	75	14%	3023.76	100	3109.76	30.0%	18.0%	3654.04	3659	3524	3522	4314	3926	3833.8	3833.8	5.3	3.066												

55	3448	84	75	13%	2999.76	100	3083.76	29.8%	17.9%	3620.12	3627	3517	3490	4289	3931	3673.6	3673.6	4.9	3.162												
56	3333	84	75	16%	2799.72	100	2883.72	32.8%	19.7%	3434.70	3482	3364	3355	4007	3748	3747.5	3747.5	5.4	3.041												
57	3506	85	75	12%	3085.28	100	3170.28	30.0%	18.0%	3725.63	3730	3559	3648	4414	4503	4179.6	4179.6	4.5	3.259	0.2869	91.98	1.6	16.7	0.279	50.96	0.84	2.41	1	26.88	29.38	119.8
58	3840	82	75	14%	3302.40	100	3384.40	30.0%	18.0%	3978.83	4000	3872	3835	4410	4289	4129.6	4129.6	4.4	3.283	0.2914	75.32	1.29	13.24	0.215	83.17	1.38	2.31	0.8	24.34	35.7	109.9
59	3718	84	75	13%	3234.66	100	3318.66	29.8%	17.9%	3897.02	3936	3738	3810	4468	4222	4135.0	4135.0	4.6	3.235	0.2863	80.72	1.41	15.05	0.251	68.16	1.15					
60	3576	82	75	16%	3003.84	100	3085.84	32.8%	19.7%	3677.00	3694	3473	3613	4048	4072	4227.9	4227.9	4.9	3.162	0.2828	97.98	1.73	17.5	0.297	48.08	0.81	2.89	0.8	31.21	22.14	88
61	3937	84	75	15%	3346.45	100	3430.45	31.8%	19.1%	4068.95	4051	3845	3942	4609	4384	4561.7	4561.7	3.9	3.404	0.3089	81.47	1.32	15.38	0.238	62.81	0.98	3.72	0.7	33.59	32.59	94.7
62	3605	88	75	16%	3028.20	100	3116.20	32.4%	19.4%	3704.88	3718	3540	3604	4011	4062	4019.2	4019.2	4.3	3.307	0.287	92.28	1.61	15.23	0.253	50.53	0.84	3.32	0.7	31.98	25.24	106.8

63	3690	85	75	14%	3173.40	100	3258.40	29.1%	17.5%	3812.48	3830	3628	3683	4105	4014	3581.4	3581.4	4.8	3.186	0.2829	69.02	1.22	13.55	0.227	99.48	1.71	2.41	1	26.88	29.38	119.8
64	3724	81	75	15%	3165.40	100	3246.40	27.3%	16.4%	3764.89	3805	3660	3698	3978	4253	3819.3	3819.3	4.9	3.162	0.2981	86.72	1.45	15.05	0.241	113.77	1.87	2.31	0.8	24.34	35.7	109.9
65	3544	83	75	16%	2976.96	100	3059.96	31.9%	19.1%	3629.75	3633	3504	3544	3644	4025	3487.6	3487.6	5.3	3.066	0.2848	84.17	1.48	14.83	0.248	297	5.17					
66	3588	88	75	16%	3013.92	100	3101.92	30.1%	18.1%	3646.23	3646	3571	3561	3962	3907	3622.4	3622.4	5.3	3.066	0.2805	65.27	1.16	13.97	0.237	138	2.42	2.89	0.8	31.21	22.14	88
67	3700	84	75	16%	3108.00	100	3192.00	30.4%	18.2%	3758.90	3833	3662	3714	3853	4072	3774.3	3774.3	4.8	3.186	0.2818	61.52	1.09	13.15	0.221	110.39	1.91	3.72	0.7	33.59	32.59	94.7
68	3660	85	75	16%	3074.40	100	3159.40	29.0%	17.4%	3694.35	3801	3632	3644	3917	4055	3699.5	3699.5	4.7	3.210	0.299	55.97	0.94	14.65	0.233	136.78	2.25	3.32	0.7	31.98	25.24	106.8
69	3943	90	75		3943.00	100	4033.00		0.0%	4033.00	4030	3914	3773	3988	4213	4441.4	4441.4	4.2	3.331	0.2912	30.91	0.53	12.84	0.208	61.523	1.01	3.3	0.9	31.6	49.5	99.4
70	3518	86	75	12%	3095.84	100	3181.84	30.0%	18.0%	3739.09	3747	3500	3582	4078	4113	4173.4	4173.4	4.9	3.162	0.3023	85.67	1.42	16.67	0.264	63.306	1.01	3.3	0.9	31.6	49.5	99.4

71	3763	86	75	14%	3236.18	100	3322.18	30.0%	18.0%	3904.69	3908	3705	3780	4071	4092	4116.1	4116.1	4.4	3.283	0.2918	76.67	1.31	14.16	0.231	81.098	1.35	12.44	0.6	2.41	39.01	137.7
72	3823	82	75	13%	3326.01	100	3408.01	29.8%	17.9%	4002.70	4003	3808	3905	4601	4295	4085.7	4085.7	4.4	3.283	0.29	73.97	1.28	14.04	0.23	70.4	1.17	12.84	0.7	1.91	46.03	124.4
73	3633	82	75	16%	3051.72	100	3133.72	32.8%	19.7%	3734.30	3854	3670	3723	4434	4436	4134.5	4134.5	4.5	3.259	0.2901	73.97	1.27	14.28	0.234	60.173	0.99					
74	3502	92	75	15%	2976.70	100	3068.70	31.8%	19.1%	3636.65	3712	3548	3618	3976	4032	4272.4	4272.4	4.3	3.307	0.2995	89.28	1.49	16.52	0.264	57.511	0.92	3.52	0.78	19.75	27.67	104.2
75	3528	85	75	16%	2963.52	100	3048.52	32.4%	19.4%	3624.63	3679	3538	3615	4406	4306	4147.5	4147.5	4.8	3.186	0.2807	104.13	1.85	17.35	0.296	45.095	0.76	3	0.8	31.1	31.2	115.8
76	3720	85	75	14%	3199.20	100	3284.20	29.1%	17.5%	3842.78	3861	3650	3744	4152	4155	3956.4	3956.4	4.8	3.186	0.2907	69.32	1.19	15.02	0.246	117.295	1.97	3.3	0.9	31.6	49.5	99.4
77	3754	83	75	15%	3190.90	100	3273.90	27.3%	16.4%	3796.57	3821	3671	3734	4310	4070	3929.6	3929.6	4.8	3.186	0.292	81.92	1.4	15.26	0.249	117.511	1.97	12.44	0.6	2.41	39.01	137.7
78	3576	83	75	16%	3003.84	100	3086.84	31.9%	19.1%	3661.77	3699	3570	3665	3991	3963	3693.8	3693.8	4.9	3.162	0.2824	94.83	1.68	15.97	0.27	162.473	2.83	12.84	0.7	1.91	46.03	124.4

79	3660	85	75	16%	3074.40	100	3159.40	30.1%	18.1%	3714.64	3768	3647	3707	4061	4006	3760.2	3760.2	4.9	3.162	0.3005	89.58	1.49	15.6	0.248	149.385	2.44					
80	3645	86	75	16%	3061.80	100	3147.80	30.4%	18.2%	3706.27	3911	3745	3789	4237	4154	3670.3	3670.3	5.6	2.993	0.2933	85.67	1.46	15.35	0.25	114.429	1.91	3.52	0.78	19.75	27.67	104.2
81	3684	85	75	16%	3094.56	100	3179.56	29.0%	17.4%	3718.01	3806	3633	3671	3815	4156	3753.3	3753.3	5.2	3.090	0.2924	45.76	0.78	13.7	0.222	129.41	2.17					
82	5000	88	75		5000.00	100	5088.00		0.0%	5088.00	5065	4946	5043	5201	4831	4933.0	4933.0	5.3	3.066								12.84	0.7	1.91	46.03	124.4
83	3648	95	75	12%	3210.24	100	3305.24	30.0%	18.0%	3883.08	3884	3661	3762	4173	4060	4236.9	4236.9	4.6	3.235	0.3004	91.23	1.52	17.93	0.287	60.655	0.97	2.41	1	26.88	29.38	119.8
84	3780	86	75	14%	3250.80	100	3336.80	30.0%	18.0%	3921.94	3925	3763	3808	4420	4217	4049.8	4049.8	4.7	3.210	0.2989	69.93	1.17	13.45	0.213	79.018	1.28	2.31	0.8	24.34	35.7	109.9
85	3879	90	75	13%	3374.73	100	3464.73	29.8%	17.9%	4068.13	4063	3863	3959	4167	4320	4288.0	4288.0	4.2	3.331	0.292	83.42	1.43	14.89	0.243	73.93	1.22					
86	3649	94	75	16%	3065.16	100	3159.16	32.8%	19.7%	3762.38	3916	3727	3745	4040	4140	4307.3	4307.3	4.3	3.307	0.2835	76.22	1.34	15.08	0.254	59.786	1.01	2.89	0.8	31.21	22.14	88

94.7	106.8	119.8	109.9		88	94.7	106.8
32.59	25.24	29.38	35.7		22.14	32.59	25.24
33.59	31.98	26.88	24.34		31.21	33.59	31.98
0.7	0.7	1	0.8		0.8	0.7	0.7
3.72	3.32	2.41	2.31		2.89	3.72	3.32
2.3	0.91	1.71	1.72	2.45	2.36	2.23	2.35
136.806	55.906	99.069	103.355	147.35	147.7	132.55	139.681
0.227	0.253	0.247	0.238	0.267	0.248	0.232	0.232
13.91	15.6	14.62	14.68	16.52	16	14.07	14.1
1.26	1.58	1.23	1.36	1.47	1.83	1.32	1.07
73.37	93.33	69.62	79.52	87.02	112.38	76.82	62.42
0.2915	0.2947	0.2823	0.2934	0.2961	0.3078	0.2894	0.2903
3.307	3.138	3.235	3.066	2.945	3.162	3.090	3.090
4.3	5.0	4.6	5.3	5.8	4.9	5.2	5.2
4165.7	4133.0	3965.5	3662.5	3445.3	3620.8	3659.3	3831.3
4165.7	4133.0	3965.5	3662.5	3445.3	3620.8	3659.3	3831.3
4037	4180	4102	4023	3911	4046	3976	4161
3803	4131	3900	4109	3916	3895	3943	3850
3757	3551	3671	3536	3553	3685	3573	3765
3645	3465	3659	3478	3453	3600	3563	3767
3818	3626	3856	3647	3579	3732	3713	3958
3737.92	3620.60	3853.88	3579.04	3562.70	3629.41	3692.37	3822.59
19.1%	19.4%	17.5%	16.4%	19.1%	18.1%	18.2%	17.4%
31.8%	32.4%	29.1%	27.3%	31.9%	30.1%	30.4%	29.0%
3153.10	3045.96	3293.80	3088.25	3004.16	3088.28	3136.04	3269.08
100	100	100	100	100	100	100	100
3065.10	2955.96	3207.80	2996.25	2918.16	2996.28	3050.04	3181.08
15%	16%	14%	15%	16%	16%	16%	16%
75	75	75	75	75	75	75	75
88	90	86	92	86	92	86	88
3606	3519	3730	3525	3474	3567	3631	3787
87	88	89	90	91	92	93	94

88	133	135.5	126.5	137.6	131.6	81.5	104.8
22.14	161.96	82.44	77.95	60.9	69	53.85	88.1
31.21	24.37	26.98	25.34	29.64	30.89	26.07	29.97
0.8	1.2	1.2	1.61	1.11	1	0.7	2.41
2.89	1.81	2.61	2.41	2.33	2.31	2.31	1.91
	2.17	2.93	1.23	1.32	1.12	1.15	4.26
	127.809	181.265	77.681	82.382	69.964	72.667	251.706
	0.258	0.219	0.254	0.239	0.241	0.23	0.249
	15.41	13.91	15.97	14.95	14.95	14.46	15.11
	1.39	1.61	1.7	1.32	1.41	1.56	1.39
	79.97	97.83	102.78	79.22	84.17	94.23	81.32
	0.287	0.3032	0.3026	0.3002	0.2972	0.3011	0.2912
3.331	3.210	3.235	3.283	3.162	3.210	3.162	3.162
4.2	4.7	4.6	4.4	4.9	4.7	4.9	4.9
4767.4	4211.6	3984.8	4087.4	4078.1	4161.5	3997.2	4076.5
4767.4	4211.6	3984.8	4087.4	4078.1	4161.5	3997.2	4076.5
4616	4464	4199	4196	4082	4111	4091	4202
4454	4502	4075	4531	3896	4223	4326	4009
4228	3707	3790	3812	3643	3622	3667	3861
4325	3618	3679	3792	3573	3582	3582	3806
4489	3782	3896	3976	3768	3745	3733	3999
4487.00	3776.59	3893.53	3972.88	3766.46	3636.78	3701.87	3997.33
0.0%	18.0%	18.0%	17.9%	19.7%	19.1%	19.4%	17.5%
	30.0%	30.0%	29.8%	32.8%	31.8%	32.4%	29.1%
4487.00	3213.16	3312.72	3383.17	3160.76	3067.20	3113.84	3415.78
100	100	100	100	100	100	100	100
4402.00	3130.16	3226.72	3298.17	3077.76	2985.20	3024.84	3330.78
	12%	14%	13%	16%	15%	16%	14%
75	75	75	75	75	75	75	75
85	83	86	85	83	82	89	85
4402	3557	3752	3791	3664	3512	3601	3873
95	96	97	98	99	100	101	102

103	3665	85	75	15%	3115.25	100	3200.25	27.3%	16.4%	3710.53	4011	3819	3896	4412	4224	4142.6	4142.6	4.2	3.331	0.2952	102.93	1.74	15.6	0.254	120.93	1.99	1.61	1.91	24.14	98.16	103.6
104	3417	83	75	16%	2870.28	100	2953.28	31.9%	19.1%	3502.65	3618	3497	3565	3934	3944	3910.1	3910.1	5.6	2.993	0.2959	97.23	1.64	15.87	0.258	164.881	2.73	1.5	2	32.4	134.7	172.6
105	3677	86	75	16%	3088.68	100	3174.68	30.1%	18.1%	3732.50	3769	3665	3704	3846	4136	3759.8	3759.8	5.2	3.090	0.2895	83.42	1.44	14.8	0.245	149.339	2.52	1.89	1.7	29.72	106.6	144.6
106	3722	83	75	16%	3126.48	100	3209.48	30.4%	18.2%	3779.75	3888	3745	3770	4125	4181	3925.4	3925.4	5.2	3.090	0.2918	74.72	1.28	14.22	0.233	122.106	2.03	2.01	1.91	39.63	132.36	149.7
107	3749	83	75	16%	3149.16	100	3232.16	29.0%	17.4%	3780.11	3790	3625	3646	3775	4139	3676.9	3676.9	4.9	3.162	0.2905	50.56	0.87	13.88	0.228	139.483	2.34	2.42	2.04	29.47	89.2	130.4
108	4081	86	75		4081.00	100	4167.00		0.0%	4167.00	4193	3873	3889	4099	4338	4465.8	4465.8	5.3	3.066								3.52	0.78	19.75	27.67	104.2
109	3529	82	75	12%	3105.52	100	3187.52	30.0%	18.0%	3746.51	3762	3579	3667	4555	4464	4113.6	4113.6	4.8	3.186	0.3023	90.63	1.5	17.47	0.279	70.523	1.11					
110	3667	88	75	14%	3153.62	100	3241.62	30.0%	18.0%	3809.27	3823	3633	3705	4204	4174	4067.5	4067.5	4.8	3.186	0.296	78.47	1.32	13.36	0.215	87.551	1.42					

		119.8	109.9		88	94.7	106.8
		29.38	35.7		22.14	32.59	25.24
		26.88	24.34		31.21	33.59	31.98
		1	0.8		0.8	0.7	0.7
		2.41	2.31		2.89	3.72	3.32
5.4							
328.034							
0.259							
16.18							
1.48							
88.98							
0.3005							
3.162	3.428	3.186	3.162	3.283	3.428	3.331	3.307
4.9	3.8	4.8	4.9	4.4	3.8	4.2	4.3
4207.7	4432.0	4145.4	3833.4	4053.2	4427.6	4088.7	3907.6
4207.7	4432.0	4145.4	3833.4	4053.2	4427.6	4088.7	3907.6
4046	4277	4485	4183	4272	4590	4187	4188
4296	4467	4381	4133	4287	4496	4090	4267
3712	3925	3751	3755	3916	3915	3703	3682
3746	3890	3663	3634	3813	3856	3633	3595
3932	4081	3839	3827	4030	4037	3785	3746
3931.94	4081.12	3829.51	3815.39	4010.91	3909.22	3750.14	3736.00
17.9%	19.7%	18.0%	18.0%	17.9%	19.7%	19.1%	19.4%
29.8%	32.8%	30.0%	30.0%	29.8%	32.8%	31.8%	32.4%
3347.98	3424.00	3258.16	3246.50	3414.97	3280.04	3162.40	3141.44
100	100	100	100	100	100	100	100
3265.98	3339.00	3174.16	3160.50	3332.97	3197.04	3080.40	3058.44
13%	16%	12%	14%	13%	16%	15%	16%
75	75	75	75	75	75	75	75
82	85	84	86	82	83	82	83
3754	3975	3607	3675	3831	3806	3624	3641
111	112	113	114	115	116	117	118

119	3687	87	75	14%	3170.82	100	3257.82	29.1%	17.5%	3811.45	3823	3629	3688	3786	3832	3671.0	3671.0	4.7	3.210								2.41	1	26.88	29.38	119.8
120	3676	83	75	15%	3124.60	100	3207.60	27.3%	16.4%	3719.41	3776	3666	3764	3956	4053	3729.1	3729.1	4.6	3.235								2.31	0.8	24.34	35.7	109.9
121	3501	85	75	16%	2940.84	100	3025.84	31.9%	19.1%	3588.72	3700	3589	3633	3668	3967	3734.3	3734.3	5.2	3.090												
122	3508	86	75	16%	2946.72	100	3032.72	30.1%	18.1%	3564.90	3827	3687	3804	3990	4157	3758.8	3758.8	5.1	3.114								2.89	0.8	31.21	22.14	88
123	3758	82	75	16%	3156.72	100	3238.72	30.4%	18.2%	3814.51	3825	3662	3741	3828	4075	3701.7	3701.7	5.2	3.090								3.72	0.7	33.59	32.59	94.7
124	3636	83	75	16%	3054.24	100	3137.24	29.0%	17.4%	3668.68	3698	3585	3637	3698	4078	4027.8	3550.3	5.3	3.066								3.32	0.7	31.98	25.24	106.8
125	4751	83	75		4751.00	100	4834.00		0.0%	4834.00	4786	4553	4548	4559	4768	4742.9	4742.9	4.7	3.210								2.31	0.8	24.34	35.7	109.9
126	3565	84	75	12%	3137.20	100	3221.20	30.0%	18.0%	3785.90	3788	3659	3780	4326	4408	4217.8	4217.8	4.3	3.307								3.3	0.9	31.6	49.5	99.4

137.7	124.4		104.2	115.8	99.4	137.7	124.4
39.01	46.03		27.67	31.2	49.5	39.01	46.03
2.41	1.91		19.75	31.1	31.6	2.41	1.91
0.6	0.7		0.78	0.8	0.9	0.6	0.7
12.44	12.84		3.52	3	3.3	12.44	12.84
3.259	3.210	3.186	3.283	3.138	3.041	3.307	3.017
4.5	4.7	4.8	4.4	5.0	5.4	4.3	5.5
4002.7	3867.8	3920.0	4260.8	4266.2	3637.9	3757.5	3612.3
4002.7	3867.8	3920.0	4260.8	4266.2	3637.9	3757.5	3612.3
4277	4127	4159	4604	4447	4043	3966	3991
4168	4147	4099	4406	4312	3806	3869	3716
3923	3645	3708	3870	3632	3604	3644	3582
3880	3631	3526	3799	3517	3519	3590	3518
4025	3854	3686	3973	3655	3677	3741	3644
4010.23	3854.97	3684.01	3859.36	3624.63	3669.00	3691.73	3644.76
18.0%	17.9%	19.7%	19.1%	19.4%	17.5%	16.4%	19.1%
30.0%	29.8%	32.8%	31.8%	32.4%	29.1%	27.3%	31.9%
3411.62	3282.99	3092.36	3255.40	3048.36	3136.70	3184.10	3072.40
100	100	100	100	100	100	100	100
3325.62	3198.99	3006.36	3165.40	2964.36	3048.70	3099.10	2990.40
14%	13%	16%	15%	16%	14%	15%	16%
75	75	75	75	75	75	75	75
86	84	86	90	84	88	85	82
3867	3677	3579	3724	3529	3545	3646	3560
127	128	129	130	131	132	133	134

135	3890	84	75	16%	3267.60	100	3351.60	30.1%	18.1%	3941.73	3954	3833	3865	3896	4173	3774.1	3774.1	5.0	3.138												
136	3959	92	75	16%	3325.56	100	3417.56	30.4%	18.2%	4024.14	4157	3953	4031	4218	4440	3937.8	3937.8	4.1	3.355								3.52	0.78	19.75	27.67	104.2
137	3721	83	75	16%	3125.64	100	3208.64	29.0%	17.4%	3752.50	3841	3671	3738	3709	4044	3699.9	3699.9	5.2	3.090												
138	4633	87	75		4633.00	100	4720.00		0.0%	4720.00	4618	4490	4754	4870	4663	4505.1	4505.1	6.3	2.824												
139	3460	87	75	12%	3044.80	100	3131.80	30.0%	18.0%	3679.86	3682	3505	3717	4222	4246	3846.5	3846.5	4.8	3.186								2.41	1	26.88	29.38	119.8
140	3737	89	75	14%	3213.82	100	3302.82	30.0%	18.0%	3881.31	3885	3726	3810	4131	4198	4073.8	4073.8	4.8	3.186								2.31	0.8	24.34	35.7	109.9
141	3852	88	75	13%	3351.24	100	3439.24	29.8%	17.9%	4038.44	4043	3876	3927	4277	4358	3995.2	3995.2	4.7	3.210												
142	3649	90	75	16%	3065.16	100	3155.16	32.8%	19.7%	3758.38	3834	3684	3774	4068	4257	3550.3	4027.8	4.8	3.186								2.89	0.8	31.21	22.14	88

94.7	106.8	119.8		109.9	88	94.7	106.8
32.59	25.24	29.38		35.7	22.14	32.59	25.24
33.59	31.98	26.88		24.34	31.21	33.59	31.98
0.7	0.7	1		0.8	0.8	0.7	0.7
3.72	3.32	2.41		2.31	2.89	3.72	3.32
3.210	3.162	3.138	3.500	3.017	3.066	2.993	3.210
4.7	4.9	5.0	3.5	5.5	5.3	5.6	4.7
4054.8	3931.2	3478.1	4085.4	3596.8	3811.7	3661.3	3705.2
4054.8	3931.2	3478.1	4085.4	3596.8	3811.7	3661.3	3705.2
4302	4453	3917	4311	3904	4207	4018	4099
4075	4237	3712	4229	3628	3904	3726	3723
3758	3657	3519	3906	3550	3857	3709	3700
3714	3534	3449	3830	3458	3789	3692	3632
3866	3660	3625	3979	3569	3927	3802	3813
3836.09	3655.72	3618.45	3892.62	3527.67	3803.93	3612.94	3745.68
19.1%	19.4%	17.5%	16.4%	19.1%	18.1%	18.2%	17.4%
31.8%	32.4%	29.1%	27.3%	31.9%	30.1%	30.4%	29.0%
3235.70	3075.20	3094.26	3357.70	2975.40	3235.80	3069.64	3203.72
100	100	100	100	100	100	100	100
3146.70	2986.20	3002.26	3265.70	2885.40	3145.80	2978.64	3114.72
15%	16%	14%	15%	16%	16%	16%	16%
75	75	75	75	75	75	75	75
89	89	92	92	90	90	91	89
3702	3555	3491	3842	3435	3745	3546	3708
143	144	145	146	147	148	149	150

94.7	133	135.5	126.5	137.6	131.6	81.5	104.8
32.59	161.96	82.44	77.95	60.9	69	53.85	88.1
33.59	24.37	26.98	25.34	29.64	30.89	26.07	29.97
0.7	1.2	1.2	1.61	1.11	1	0.7	2.41
3.72	1.81	2.61	2.41	2.33	2.31	2.31	1.91
3.283	3.259	3.259	3.259	3.259	3.379	3.283	3.186
4.4	4.5	4.5	4.5	4.5	4.0	4.4	4.8
4473.2	3866.2	3873.1	4070.1	4064.4	4049.1	4156.5	3778.3
4473.2	3866.2	3873.1	4070.1	4064.4	4049.1	4156.5	3778.3
4418	4263	4071	4481	4318	4148	4409	4267
4206	4238	4022	4245	4137	4089	4353	3973
4007	3740	3721	3935	3757	3763	3810	3822
4047	3503	3678	3879	3686	3702	3642	3762
4255	3648	3849	4058	3838	3907	3778	3992
4251.00	3648.64	3844.79	4000.62	3775.52	3893.86	3743.01	3985.20
0.0%	18.0%	18.0%	17.9%	19.7%	19.1%	19.4%	17.5%
	30.0%	30.0%	29.8%	32.8%	31.8%	32.4%	29.1%
4251.00	3105.64	3271.72	3406.40	3168.16	3283.25	3147.96	3405.60
100	100	100	100	100	100	100	100
4164.00	3016.64	3183.72	3323.40	3086.16	3200.25	3060.96	3319.60
	12%	14%	13%	16%	15%	16%	14%
75	75	75	75	75	75	75	75
87	89	88	83	82	83	87	86
4164	3428	3702	3820	3674	3765	3644	3860
151	152	153	154	155	156	157	158

103.6	172.6	144.6	149.7	130.4	106.8		
98.16	134.7	106.6	132.36	89.2	25.24		
24.14	32.4	29.72	39.63	29.47	31.98		
1.91	2	1.7	1.91	2.04	0.7		
1.61	1.5	1.89	2.01	2.42	3.32		
3.186	3.210	3.307	3.259	3.090	3.404	3.186	3.186
4.8	4.7	4.3	4.5	5.2	3.9	4.8	4.8
3805.0	3664.8	4143.3	4018.5	3588.4	4571.8	4021.0	4243.0
3805.0	3664.8	4143.3	4018.5	3588.4	4571.8	4021.0	4243.0
4026	3924	4391	4199	4000	4502	4093	4383
4142	3705	4133	4030	3658	4290	3713	4227
3780	3666	4028	3885	3674	4113	3532	3743
3687	3565	3949	3880	3598	4170	3491	3597
3826	3706	4086	4031	3770	4336	3651	3728
3705.56	3625.75	4053.82	3864.21	3701.25	4289.00	3636.72	3720.94
16.4%	19.1%	18.1%	18.2%	17.4%	0.0%	19.1%	19.4%
27.3%	31.9%	30.1%	30.4%	29.0%		31.8%	32.4%
3195.70	3056.60	3447.00	3281.84	3165.28	4289.00	3067.95	3129.16
100	100	100	100	100	100	100	100
3112.70	2973.60	3360.00	3192.84	3080.28	4209.00	2980.95	3044.16
15%	16%	16%	16%	16%		15%	16%
75	75	75	75	75	75	75	75
83	83	87	89	85	80	87	85
3662	3540	4000	3801	3667	4209	3507	3624
159	160	161	162	163	164	165	166

167	3580	87	75	15%	3043.00	100	3130.00	31.8%	19.1%	3710.60	3733	3584	3559	4064	4069	4005.2	4005.2	4.6	3.235												
168	3601	83	75	16%	3024.84	100	3107.84	32.4%	19.4%	3695.87	3705	3552	3703	4176	4320	3895.0	3895.0	4.9	3.162												