Development of prediction models through Near-Infrared Spectroscopy (NIRS) and Biochemical Analysis for Hemp Cell Wall Content and Lignin

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Abstract

Hemp (*Cannabis sativa* L.) as one of the fastest growing plants, and it was one of the first plants used for obtain fibres around 10,000 years ago. Hemp becomes a very important multi-purpose commercial crop now, which is used for paper, textiles, plastic, clothing, painting, biofuel, food and animal bedding. As hemp not only has high yield and produces high quality fibres, it is also an environmentally friendly crop with low requirements on fertilisers and virtually free from pests. High cellulose content, low component of lignification and reducing the cross links between pectin and the structural components of the cell wall are required for high quality fibre. To study the hemp cell wall composition and lignin, prediction models were developed by using NIRS spectrum data and biochemical data. The biochemical data were collected from Cell Wall Residue (CWR), Acid Detergent Lignin (ADL) and Klason Lignin (KL). After prediction models with good quality were developed, the prediction results showed that accessions, locations and their interactions had significant influence on cell wall content and lignin. The phenotypic variation had a stronger location influence than the genetic component on all the traits. However, the effect of the location is higher on the CWR%_dm than on the lignin.

Keywords: Hemp, fibre quality, cell wall composition, lignin, NIRS, biochemical analysis, prediction model.

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1. Introduction

1.1 Overview of Hemp

Hemp (*Cannabis sativa* L.) has 2n=20 chromosomes (Mandolino et al., 1999), which belongs to *Cannabis* in Cannabaceae family. According to Hillig's research (2015), there are three main species of *Cannabis*: *Cannabis sativa, Cannabis indica* and *Cannabis ruderalis*. Hemp is considered to be originated in western and central Asia, including Russia, China, India, Pakistan and Iran (Anwar et al., 2006). As it is one of the fastest growing plants, and was one of the first plants used for obtain fibres around 10,000 years ago (Tourangeau, 2015), hemp becomes a very important commercial crop now, which is used for paper, textiles, plastic, clothing, painting, biofuel, food and animal bedding (Keller, 2013). Although the cultivation of hemp has reduced because of new competitors like cotton and synthetic fibres, production of hemp still reached almost 70,000 metric tonnes in 2013 (FAO).

Normally, hemp is planted between March and May in the northern hemisphere and between September and November in the southern hemisphere, and it needs 3-4 months to mature. Compared to other crops, hemp is an ideal fibre crop. It not only has high yield, good quality of fibre, and low requirements on fertiliser, but also it can fit well in crop rotation schemes, which contributes a lot on soil structure improvement (Du Bois, 1982; Hanson, 1980; Toonen et al., 2004). According to a 1998 study in *Environmental Economics,* hemp is considered as an environmentally friendly crop due to decrease of land use and other environmental impacts. Besides, growing hemp can help suppress weed growth and hemp is virtually free from pests so it can be grown without pesticides (Toonen et al., 2004; Van der Werf, 2004). However, hemp is vulnerable to various pathogens, such as bacteria, fungi, nematodes and viruses. These diseases do not reduce the yield of hemp but damage the fibre quality and stunted growth (T. Randall et al., 2004). Apart from diseases effects, low temperature, poor soil structure and unreasonable of water application are also problems for hemp plant establishment. Despite this, hemp is still a sustainable plant compared to cotton. Because the latter needs intensive use of pesticides, higher fertiliser and much stricter irrigation requirements, which causes many negative effects on the environment. China used to be the biggest hemp production country, however it was replaced by France recently. The production of hemp in France takes up more than 70 percent of the whole world output, followed by China with approximately 25 percent (FAO). According to FAO, an optimum yield of hemp fibre is more than 2 metric tonnes per ha, while the current yield average is only 650 kg/ha (Graeme, 2009).

1.2 Hemp Fibre

Natural fibres are roughly divided into two categories, woody and non-wood fibres (Van den Broeck et al., 2008). In wood, a fibre is a single cell, and its properties depend on what types of cells and its function in the tree, also tree species. Non-wood fibres are the collections of individual cells and they are classified depend on which part of plant they are found (Stevens et al., 2010).

The main contents of hemp fibre are cellulose, lignin and matrix polysaccharides, including hemicelluloses and pectin, which are associated with cellulose and lignin. However, the proportion of these main components depends on the fibre-type, climate conditions during vegetative period, cultivar, growing technology and plant parts. There are also some non-structural components in hemp fibre, such as waxes, inorganic salts and nitrogenous substances (Dupeyre et al., 1998).

Hemp fibre is made up by two parts: bast and core (shives). Bast fibre belongs to non-wood fibres, located at inner bark, which is the outside part of the vascular cambium, and it is the strongest and stiffest fibre (Pickering et al., 2007). Bast fibres consist of many bundles of elementary fibres. The cell wall of the elementary fibre is made of a primary and a secondary layer, about 20-50mm long with a pericyclic form and thick cell walls from 5 to 15 µm (De Meijer, 1994; De Meijer and Keizer, 1994; Mediavilla et al., 2001; Toonen et al., 2004; Van der Werf et al., 1994b). In addition, secondary cell wall is the major proportion of bast fibres, which contains about 55% cellulose, 16% hemicelluloses, 8% pectin and 4% lignin (Hughes, 2012). The woody core which derived from the xylem tissue is about 0.5-0.6 mm long (De Meijer et al., 1994; Van der Werf et al., 1994), and it has significant higher content of lignin (~15%) (Hughes, 2012).

In the cell wall, cellulose is mainly formed of microfibrils which are highly ordered bundles of cellulose polymers and embedded in a matrix of other polysaccharides and lignin (Hughes, 2012). The microfibrils strongly helical in the secondary cell wall can be separated into three parts; S1, S2, S3. The S1 layer controls fibre stability by limiting excessive lateral cell expansion, meanwhile S3 layer resists hydrostatic pressure within the cell. As for S2, which is strongly influences the axial tensile properties of the fibre, the winding angle of it in hemp bast is normally lower than 10°, thus hemp bast has higher strength and stiffness. (Booker and Sell, 1998; Mark, 1967; Thygesen et al., 2007).

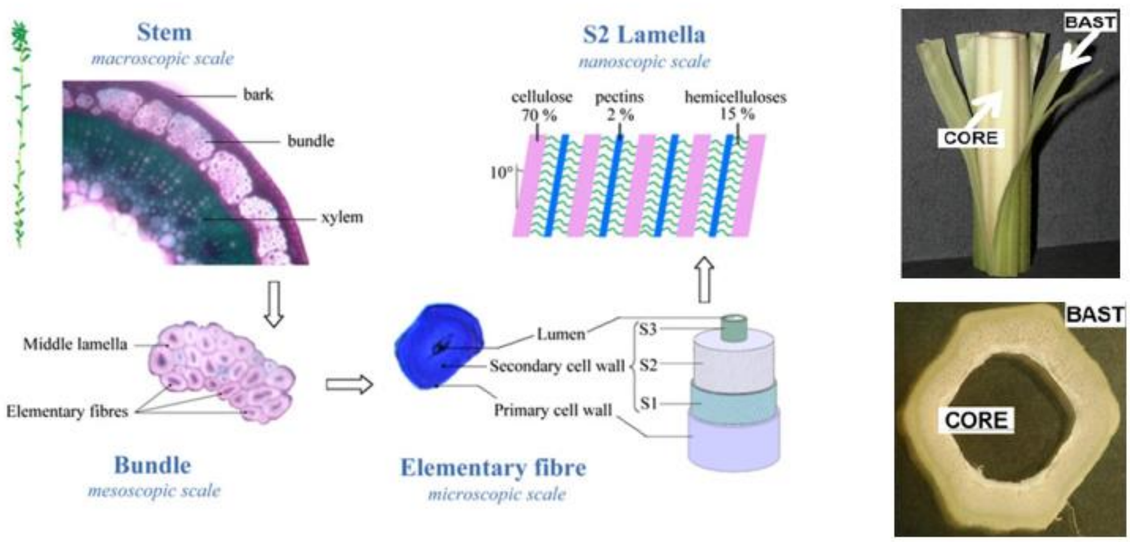

Figure 1.1 The structure of hemp cell wall (Hughes, 2012)

1.3 Hemp Application

Recently, natural vegetable fibres have been playing an increasingly important role in our day-to-day life. It has brought us a lot of benefits, such as economic viability, enhanced energy recovery, good biodegradability, low density (Dhakal et al., 2007; Le Troedec et al., 2008). However, natural fibres also have some disadvantages, like their physical and chemical properties are strongly dependent on genotype, harvest and environment (Le Troedec et al., 2008; Van de Weyenberg et al., 2006). Among the natural fibres, hemp is one of the strongest and stiffest available natural fibres, therefore it has great potential for applications in bio-composite materials (Pickering et al., 2007; Pickering et al., 2005). Hemp has become popular around the world since it is an environmentally friendly and multi-purpose commercial crop with high quality fibre.

Hemp fibre quality can be determined by chemical composition, fineness, mechanical and sorption properties (Kostic et al., 2008). The proportion of chemical components influences fibre's structure, morphology and flexibility (Zofija et al., 2015). Fibre with high cellulose content provides strength and stability. Hemicellulose contributes little to stiffness and strength of fibre. The lignin in the section of amorphic cellulose can create mechanical incrustations which contribute to fibre lignification (Waśko and Mańkowski, 2004). The high content of lignin increase stiffness, makes fibre more breakable, and reduces its divisibility and spinnability (Nykter et al., 2008; Waśko and Mańkowski, 2004). Pectin presents in the middle lamella between all types of cells and hold the fibres together (Love et al., 1994), including bind the bast fibres and shives together. Because high fibre quality is also defined by good decortication features which means to separate bast fibres and shives easily (Easson and Molloy, 1996), so as for chemical composition, high fibre quality means high cellulose content, low component of lignification and reducing the cross links between pectin and the structural components of the cell wall (Mandolino and Carboni, 2004). Therefore, increasing the cellulose content and decreasing the hemicellulose, pectin and lignin content can improve fibre properties.

The bast fibres of hemp with more cellulose are normally used to make fabric, rope, paper and insulation materials. For shives, which have more lignin are used for mulch, animal bedding, construction materials, bio-composites for cars, etc. Hemp seeds can be used to produce oil used for oil-based paints or human consumption; Or they can be directly used to feed animals like bird. (Keller, 2013)

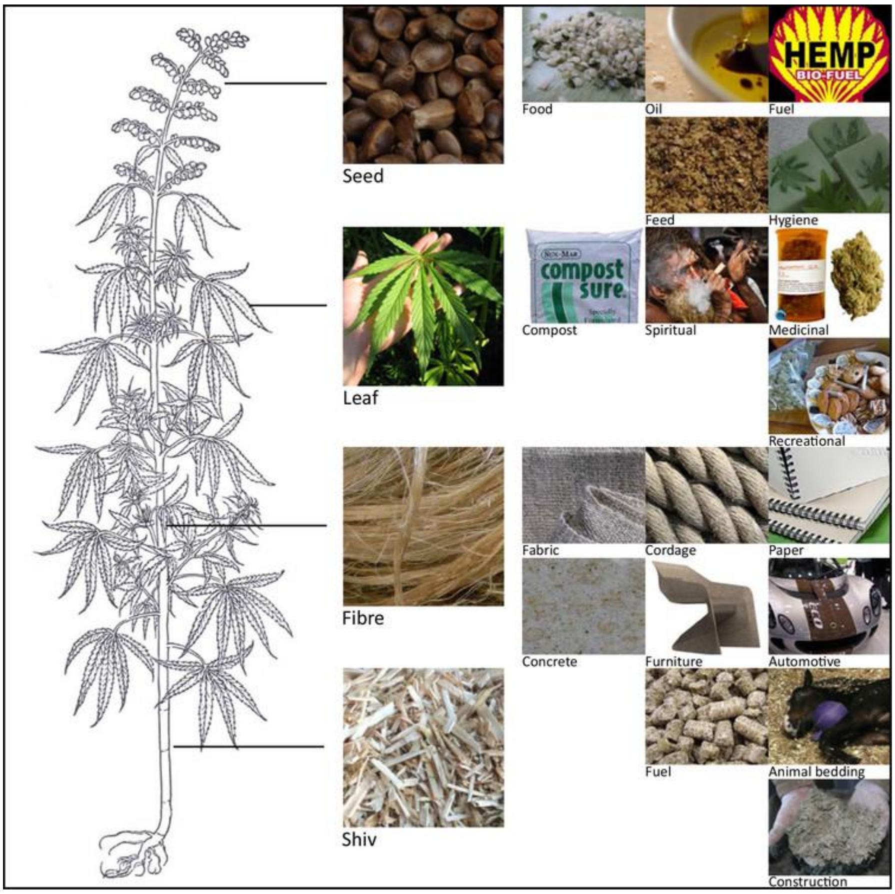

Figure 1.2 Hemp’s constituent parts and their uses (Robinson and Schultes, 1996)

1.4 Research Objectives

This thesis is part of the project “Multipurpose Hemp for industrial bio-products and biomass (MultiHemp)”, which is cooperated by 22 companies, research institutes and universities from different countries all over the world. The whole project is divided into several workpackages, and WU (Wageningen University) is responsible for workpackage 2; ‘Genome-wide association mapping for hemp breeding’. The purpose of this project is to phenotype the cell walls composition of 124 different hemp accessions to identify the genetic basis underlying hemp fibre.

The main objective of this MSc thesis is to analyse the cell wall proportion and the lignin content among the whole sample set through prediction models. This objective can be achieved by the following steps:

-Phenotype the cell wall and lignin content of 124 hemp accessions by high-throughput methods (Near-InfraRed Spectroscopy (NIRS))

-Phenotype biochemically the cell wall and lignin content of a subset of samples to develop prediction models.

-Predict the phenotype of the whole sample set

-Analyse the prediction data and find out the influence of the environment on the fibre quality.

2. Materials and Methods

2.1 Materials

In this thesis, there are 124 different hemp accessions collected from 16 different countries including Europe, China and Canada. These hemp plants were cultivated in three different locations, Rovigo (Italy), Chèvrenolles, Neuville-sur-Sarthe (France) and Westerlee (The Netherlands) at 45°N 11°E, 48°N 0.2°E and 53°N 6°E. These 124 accessions not only contain breeders' materials but also wild accessions. The aim of this set is to cover different traits, including morphological and quality. Each location has three randomly designed blocks. The experimental unit was 1 m^2 for each plot (1.5 m^2 for French field trial). Hemp accessions were harvested at full flowering and five stems were collected randomly from each plot for genotype.

Each sample was cut into top, middle and bottom parts at different heights, which has been done by other workpackage groups. They were chopped to 2cm and put into the oven for 1.5 hours at 60 °C. The dried materials were grinded to 1mm diameter by the grinder machine 'Pepping 200AN' and packaged in a zipper plastic bags separately.

2.2 Methods

2.2.1 Near Infrared Spectroscopy (NIRS)

The Near Infrared spectroscopy (NIRS) is a faster and non-destructive method (Xu et al., 2013) compared to traditional wet chemical once for biomass composition analysis, so NIRS provides more accurate results. Besides, it is also a low-cost analysis. Thus, it has become a general method widely used to detect plant constituents. NIRS analysis is based on vibrational spectroscopy that monitors changes in molecular vibrations intimately associated with changes in molecular structure (Reich, 2005). After absorbing radiation, oscillating dipole moment which associated with vibrating bonds will interact with the radiation, cause a change of the dipole moment (Xu et al., 2013). The NIR spectrum is the total absorption of many chemical bonds (Toonen et al., 2004). NIRS can provide information on molecular overtones and combinations of vibrations, because the most prominent absorption bonds occurring in the NIR spectrum are related to those (Xu et al., 2013). The prediction of hemp cell wall composition is based on a set of fully characterised samples which covered broad wavelengths in the spectrum (Toonen et al., 2004).

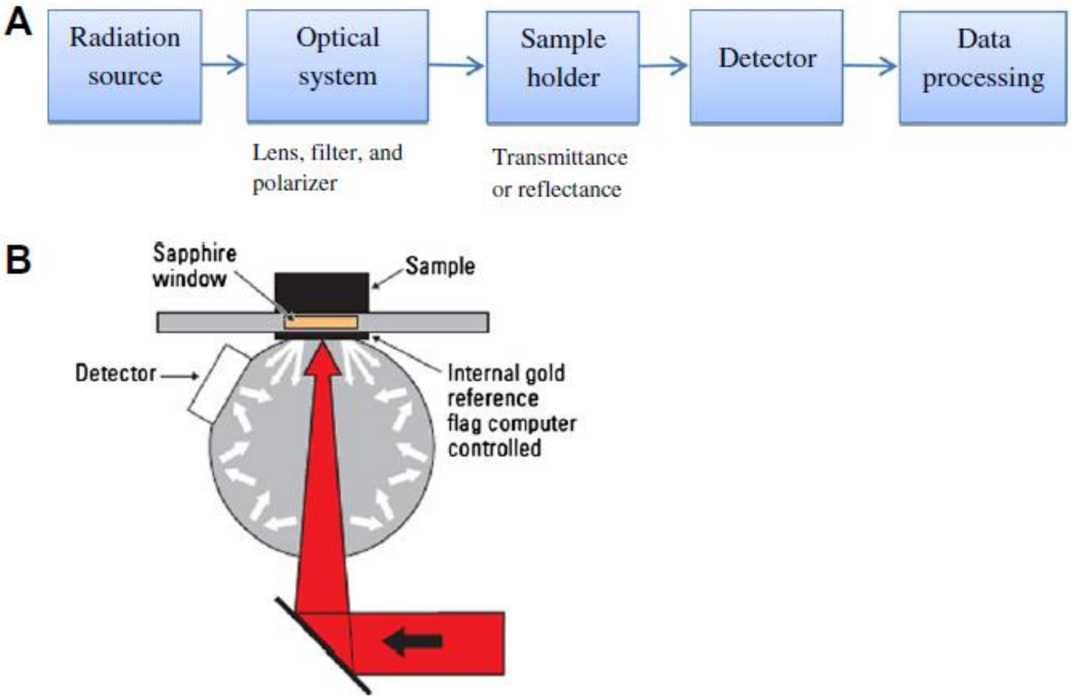

Figure 2.1 NIR schematic diagram (Xu et al., 2013)

In this thesis, instead of 1116 (124*3*3) samples, only 1034 grinded hemp samples were scanned by NIRS™ DS2500, because the rest samples were missing. After scanning, next step should be analysing biochemical data for all the samples which would be very expensive. Therefore, we need to pick out some representative samples to calibration and develop the prediction model. To do this, all the hemp spectrum data were extracted by using the software 'Mosaic Solo (NIRS DS2000)' and ranked base on their H distance by using the software 'WinISI Project Manager'. There are two standardized H distances, one is the Global H (GH), which shows how different of one sample is from the average of all samples (Shenk and Westerhaus, 1991). The spectrum with GH values higher than 3.0 was considered as an outlier. The other one is the minimum standardized H distance - the Neighbourhood H (NH). This value is the distance to the closest neighbouring sample, and it is used to control the closeness of neighbouring samples within the dataset (Olinger et al., 2001). If the NH distance from one sample to its nearest neighbour was higher than 1.5, then it also was considered as an outlier. At the end, 116 samples were selected from all the scanned hemp samples based on the variation of the NIR spectrum and were used for further biochemical analysis. Among these 116 hemp samples, 99 samples were model samples and 17 were outliers. What else, 25 samples were randomly selected from the rest 918 samples as validation samples.

2.2.2 Biochemical Analysis

The 141 selected samples were biochemically analysed by three different methods, analysis of the cell wall content using Alcohol Insoluble Solids (AIS) extraction method, analysis of the Acidic Detergent Lignin (ADL) using Goering and Van Soest's protocol (1970) (ANKOM technology), and analysis of the Acid Insoluble Lignin (Klason lignin) by using two-step hydrolysis procedure. The main difference between AIS and ANKOM technology is pectin been included or not. For AIS, which uses 80% alcohol, pectin will remain while it is not soluble in alcohol (Filomena et al., 2012). So AIS is used for major cell wall compositions detection. In general, the ANKOM technology is used to determine the neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL). As part of the pectin is soluble in water, %NDF is the sum of the cellulose, hemicellulose and lignin parts of the fibres by using a neutral detergent. %ADF and ADL%_dm are finished in one procedure using an acid detergent instead of a natural detergent. %ADF includes lignin and cellulose parts of fibres, whereas ADL%_dm only has the lignin part of the acid detergent fibres (Toonen et al., 2004). %ADF procedure was done before and in this thesis, we mainly studied lignin by using ANKOM technology, so only ADL%_dm was included. Both Klason Lignin and ADL are lignin, Klason is the standard method for wood analysis and ADL is the most common method for animal science and agronomy. Klason lignin was used two-step sulfuric acid hydrolysis while ADL was used sequential detergent analysis.

A. Alcohol Insoluble Solids (CWR)

The 141 samples were randomly divided into 7 batches, each batch had two biomass controls and one blank. This experiment has been done in two replicates. For each selected hemp sample, after proper mixed, 50(±1) mg biomass has been weighted. The biomasses were put into 2ml microcentrifuge tube and labelled. AIS can be divided into two parts, cell wall extraction and Alpha-amylase digestion.

Cell wall extraction

First step, each tube added 1.5ml 80% ethanol and was put on ice for 30'. Every 15' the tubes should be mixed properly to make sure this procedure fully reaction. Then tubes were centrifuged for 5' at 10,000g and discard supernatant. Repeated the first step for three times. This step means to remove all other things including DNA, membrane, etc., but only left cell walls for next step. Second step is 1.5ml acetone was added in each tube and waited for 10'. After that, tubes were centrifuged for 5' at 10,000g and discarded supernatant. The acetone step is same for the methanol. We used acetone and methanol to remove chlorophyll and lipids. At the end, we put the tubes in the Thermomixer overnight to remove the methanol which would inactivate the alpha-amylase in the next part.

Alpha-amylase digestion

Before start with the digestion, Tris-maleate buffer needed to be unfrozen and mixed properly. Also, the amount of α-amylase enzyme was calculated and weighted. 300µl of 10Mm Tris-maleate buffer was added into each sample. Samples were put in the Thermomixer at 30°C (room temperature) for 30'. Then samples were placed in boiling water for 5'. Next, the samples needed to be equilibrate to 40°C because 40°C is the optimal temperature for α-amylase enzyme, so we put samples on the mixture of ice and water to cooldown. After that, 100µl of α-amylase enzyme solution with 2U/mg of carbohydrate was added to each sample and waited at 40°C (Thermomixer) for 1 hour. Afterward, another half dose of α-amylase enzyme solution was applied fir 30' at 40°C (Thermomixer). We added four volumes of cold absolute ethanol, which was approximately 1800µl, and precipitate polysaccharides at -20°C (Freezer) for at least 1 hour. Then samples were centrifuged at

2,000g for 5’ and the supernatant was discarded. Repeated the cold absolute ethanol for three more times but just for wash. Finally, the samples we put in the Thermomixer overnight at 60°C to get rid of the ethanol, then the samples were dry in the oven at 103°C overnight. The dry weight of each sample was measured after oven.

B. Acid Detergent Lignin (ADL)

As the ADF was performed before this experiment, the ADF samples were directly used to perform the ADL. For this phenotyping 61 samples where completely analysed before but for the 80 resting samples, the ADF was only performed. In this thesis, the 80 samples were analysed in triplicates, so in total there were 240 ADF samples that were randomly splitted into 11 batches. Each batch included 22 samples, 1 control and 1 blank. We put one batch in a bottle with 500ml of 72% sulfuric acid. for 3 hours constantly shaking at room temperature. Samples were cleaned by demi water for three times until the pH was neutral. Then the washed samples were put in acetone for 5’ and placed in the fume hood to dry. After at least two hours in the fume hood, the samples were transferred into the oven at 103°C overnight and then the dry weight of each sample was measured.

C. Acid Insoluble Lignin/Klason Lignin (KL)

The Klason lignin was analysed by using a two-step hydrolysis with sulfuric acid. The first hydrolysis step was adding 72% sulfuric acid to samples and put in the incubator for 1 hour at 30°C. The second hydrolysis step was diluted 72% sulfuric acid to 4% with MQ water and put into autoclave for 1 hour at 121°C. Then the samples were cooling at room temperature. Afterwards, the insoluble acid fraction of the sample was filtered with a glass filter (47 mm hydrophilic glass fibre filter with a 0.7 µm pore size) and washed with demi water for several times. The residue on the glass filters was KL. The glass filters with residues were put into the oven for overnight at 103°C and dry weight of each sample was measured after oven.

D. Data analysis

The dry matter content data was provided, and the weight of empty filter bags/tubes, filter bags/tubes + samples and dry weight of filter bags + samples were measured. The controls were used to checked if each batch was correctly performed. Then all the data were corrected by the differences between initial weight and dry weight of blanks per trait. By taking into account of all the values, the percentage of CWR, ADL and KL were calculated.

$$\text{Blank correction} = \text{Blank dry weight after oven} - \text{Blank weight before oven}$$

$$DMC\% = \frac{Total\ dried\ weight - Filter\ bag\ weight - Blank\ correction}{Sample\ weight} * 100\%$$

$$\text{CWR\%\_dm or ADL\%\_dm or KL\%\_dm} = \frac{(Filter\ or\ tube + Sample) dry\ weight - Filter\ or\ tube\ weight - Blank\ correction}{Sample\ weight * DMC\%} * 100\%$$

The standard deviation (SD) and the relative standard deviation (RSD) of all samples data for each replicate per trait were also calculated. All the samples with RSD higher than 15 were considered not reliable except for the KL%_dm, because the sample weight of KL was very low thus KL treatment easily caused big errors. Since the controls from KL were similar across batches, we considered that the data was reliable. For each trait, the data was corrected in three different ways: data corrected by batch, data corrected by control and double correction data, plus the original data Then, these data were separated into two groups by sample type: calibration (models + outliers) and validation.

$$\text{Data corrected by batch} = \text{Original data} * \frac{\textit{Samples average value per batch}}{\textit{All samples average value}}$$

$$\text{Data corrected by control} = \text{Original data} * \frac{\textit{Controls average value per batch}}{\textit{All controls average value}}$$

$$\text{Double correction data} = \text{Original data} * \frac{\textit{Samples average value per batch}}{\textit{All samples average value}} * \frac{\textit{Controls average value per batch}}{\textit{All controls average value}}$$

2.2.3 Prediction Models Development

Three prediction models (CWR, ADL and KL) were developed for each set of data (Original data, data corrected by batch, data corrected by control, data corrected by batch and control). The prediction models were developed by correlating the biochemical data and the NIR spectrum data per trait.

The modelling was performed by using the software 'WinISI Project Manager' for each trait. First, a Principal component analysis (PCA) was performed to find outliers from the calibration samples. In case that there were outliers, they would be purged from the calibration sample set. 7 components were used to measure GH which included 98.34% of their spectral variability. During this analysis, the outliers of the calibration samples should have been selected and purged. After this the Modified PLS (Partial Least Squares) regression method was performed to develop the equations. Then, the calibration samples were used to develop equations with the following settings of wavelengths and math treatment: SNV and Detrend (standard one), derivative '1', gap '4', smooth '4' and smooth 2 '1', and H or R measurement, H or R value was '3'. Then the 25 randomly selected validation samples were used for validate the model. To check the quality of the model, the R^2 (squared correlation coefficient) between the predicted values with the reference value were used. When the value of R^2 is close to '1', it means this is a good model. Also, the standard error of predicted data (SEP) and the standard error of lab data (SEL) were checked. When the value of SEP is lower than three times of SEL value (SEP<3*SEL), then it considered to be a good model. Finally, the best models from the original data, corrected data by batch, corrected data by control and double correction data were chosen and all 1034 samples data were predicted for each trait (CWR, ADL, KL).

2.2.4 ANOVA Analysis

Each genotype had 9 replicates (3locations*3biological replicates). We complemented the missing data with * and the data was analysed with the software 'GenStat'. Analysis of the variances were performed (General ANOVA, GxE), using the mean plot values to evaluate the components of the phenotypic variation, including variation attributed to genotype (G), location (E) and genotype x environment interactions (GxE).

3. Results

3.1 Biochemical analysis

As it can be seen from the Table 3.1, the T-test was done for CWR%_dm, ADL%_dm and KL%_dm. There were 140 samples of CWR and KL, 141 samples of ADL. The average dry matter content value of CWR% was the highest which reached 89.57%, only 9.15% and 14.90% for ADL%_dm and KL%_dm separately. The variation of CWR%_dm was from 81.39% to 95.38%. As for lignin, the variation of KL%_dm was larger than ADL%_dm, which was from 9.82% to 20.53% and 6.55% to 14.13% respectively. Furthermore, the phenotypic variation between samples was significantly different (P=0.000<0.001) for each trait.

Table 3.1. T-test for CWR%_dm, ADL%_dm and KL%_dm

	N	Average	Min	Max	SD	RSD	P
CWR%_dm	140	89.57	81.39	95.38	2.87	3.20	.000
ADL%_dm	141	9.15	6.55	14.13	1.38	15.11	.000
KL%_dm	140	14.90	9.82	20.53	2.04	13.70	.000

As the sample variation of each trait was significant, thus all the samples were effectively used for prediction models development.

3.2 Prediction Models

Instead of 1116 samples, only 1034 hemp samples were available for model development of CWR%_dm, ADL%_dm and KL%_dm. The quality of the prediction models was shown as RSQ. The value of RSQ closer to 1, which means the model prediction value closer to real lab data, then the prediction model has a better quality. As the results of prediction models by using calibration samples showed in Table 3.2, 3.3 and 3.4, for CWR%_dm, the highest RSQ value was from the data corrected by batch, which reached 0.9014. For the original data, the RSQ of CWR%_dm was 0.8788. And for ADL%_dm model, the highest RSQ was 0.904 by using original data. As for KL%_dm, the RSQs calculated by using original data and the data corrected by batch were close, which was 0.869 and 0.879 respectively.

Table 3.2 Developed models for CWR%_dm by using calibration samples

Constituent	N	Mean	SD	Est. Min	Est. Max	SEC	RSQ
CWR%dm_ORI	115	89.6728	2.9895	80.7044	98.6412	1.0409	0.8788
CWR%dm_BATCH	112	89.6304	2.8755	81.004	98.2568	0.9027	0.9014
CWR%dm_CONTROL	115	89.6349	2.97	80.7248	98.5451	1.0647	0.8715
CWR%dm_DOUBLE	113	89.6398	2.8979	80.9461	98.3334	1.0301	0.8736

Table 3.3 Developed models for ADL%_dm by using calibration samples

Constituent	N	Mean	SD	Est. Min	Est. Max	SEC	RSQ
ADL%dm_ORI	112	9.1954	1.3753	5.0695	13.3213	0.426	0.904
ADL%dm_BATCH	111	9.1575	1.2653	5.3615	12.9534	0.4038	0.8982
ADL%dm_CONTROL	112	9.2617	1.4728	4.8434	13.68	0.5382	0.8664
ADL%dm_DOUBLE	112	9.2664	1.4239	4.9947	13.5381	0.5047	0.8743

Table 3.4 Developed models for KL%_dm by using calibration samples

Constituent	N	Mean	SD	Est. Min	Est. Max	SEC	RSQ
KL%dm_ORI	113	14.8796	2.0855	8.6229	21.1362	0.7546	0.8691
KL%dm_BATCH	114	14.9122	2.103	8.6031	21.2214	0.7316	0.879
KL%dm_CONTROL	112	15.0179	2.0541	8.8555	21.1803	0.8824	0.8155
KL%dm_DOUBLE	112	15.136	2.2231	8.4668	21.8052	1.0904	0.7594

Because the RSQs of different correction data sets were close, so after the prediction models was developed, the validation samples were used to validate the models (and the validation results were showed in Table 3.5). The quality of the prediction models by using validation samples was shown as R^2, which is the same as RSQ, just to distinguish the samples were used. The R^2 of CWR%_dm by original data model was 0.71, and the model based on the data corrected by batch had the highest $R^{2,}$ which was 0.713 close to 0.71. The R^2 of KL%_dm was lower than the R^2 of CWR%_dm. The highest R^2 of KL%_dm was 0.596 from the data corrected by batch. As for the original data, R^2 was 0.591. Among the three traits, ADL%_dm had the highest quality model that the R^2 of ADL%_dm were around 0.9, and between the four data-sets, the original data had the highest value of R^2 which reached 0.914. Even though CWR%_dm and KL%_dm had lower quality models, but compared to the previous prediction models, they had a higher value this time. So, there were some good quality prediction models for each trait which means these models would give high accuracy trait prediction values.

Table 3.5 Prediction models validated by validation samples.

R^2	Original data	By batch	By control	Double correction
CWR%_dm	0.71	0.713	0.669	0.663
KL%_dm	0.591	0.596	0.392	0.293
ADL%_dm	0.914	0.908	0.902	0.896

A higher quality prediction model for each trait was needed, meanwhile the quality value of original data and the data corrected on batch were higher than the other two data sets. Finally, the prediction model of original data for each trait was chosen, and each prediction model had a relatively high quality.

Then the original biochemical data and predicted data were put into a figure for each trait to check the model quality which was more intuitive.

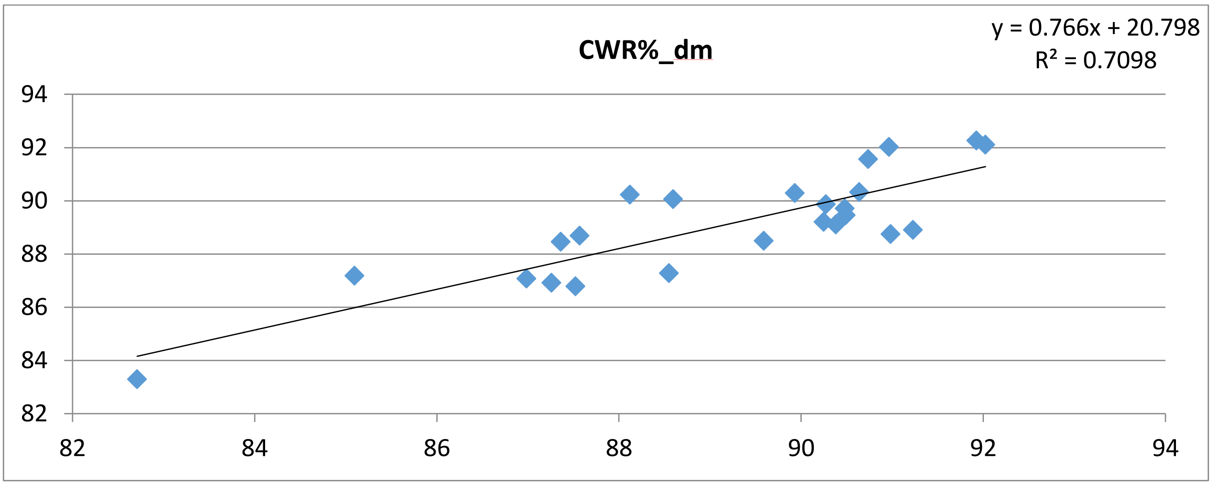

Figure 3.1 Original biochemical data vs. predicted data of validation samples of CWR%_dm. 71 percent of CWR%_dm original data can be explained by the prediction model.

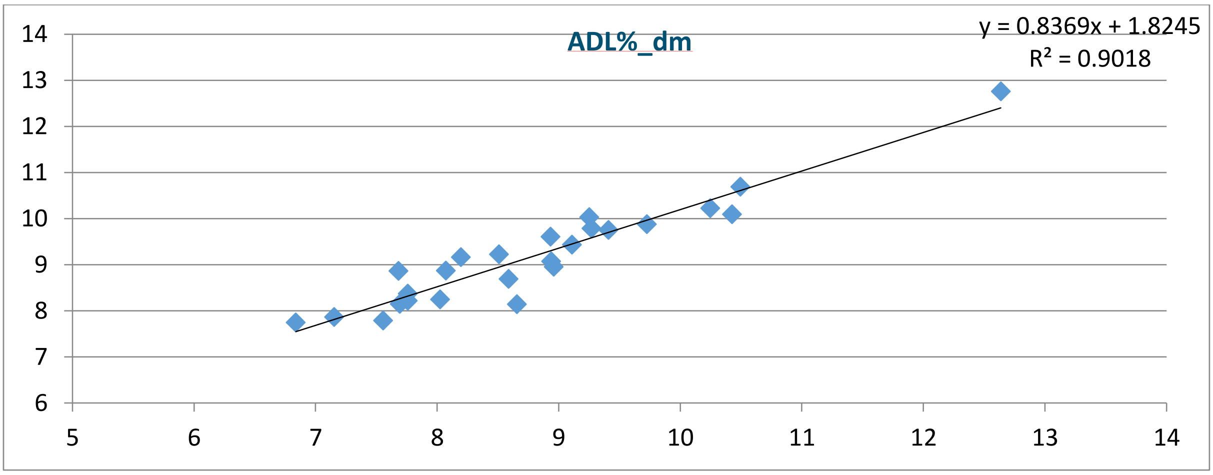

Figure 3.2 Original biochemical data vs. predicted data of validation samples of ADL%_dm. 90 percent of ADL%_dm original data can be explained by the prediction model.

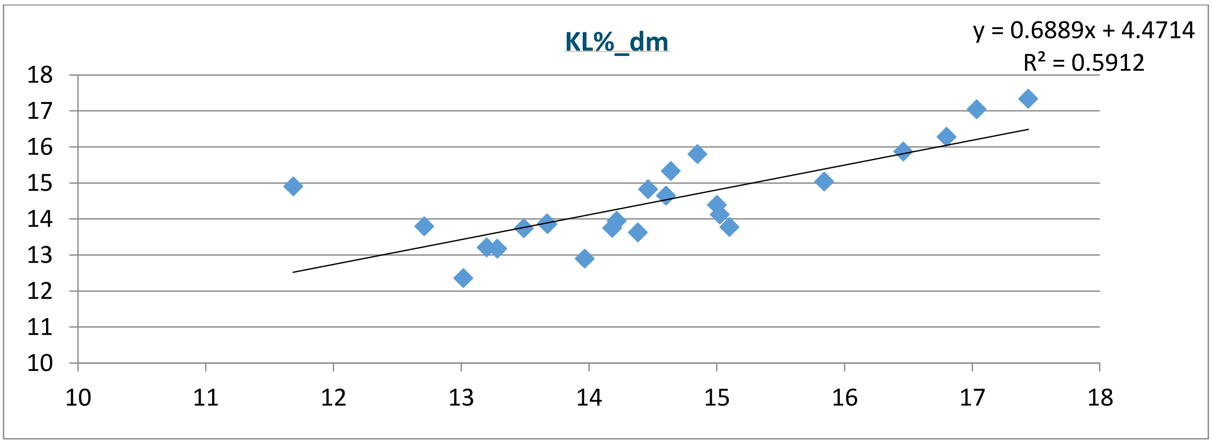

Figure 3.3 Original biochemical data vs. predicted data of validation samples of KL%_dm. 59 percent of KL%_dm original data can be explained by the prediction model.

3.3 ANOVA analysis

All the analysis of the variance was performed by using the predicted data from the original data set as the quality was good enough. The influences of genotype (accessions) and environment (locations) on the experiment data and if they had interactions were checked by general ANOVA model.

If the F value smaller than 0.001, then the influence of that treatment was significant. From the Table 3.6, 3.7 and 3.8, it can be observed that the F value of entry (accessions), locations and the interaction between them was smaller than 0.001 for CWR%_dm, ADL%_dm and KL%_dm. Thus, the influence of accessions, locations and the interaction between accessions and locations were significant for each trait.

Furthermore, from v.r. showed in the Table 3.6, 3.7 and 3.8, if the variance ratio value was larger, which means the influence was stronger. For CWR%_dm, the variance ratio of location was 1959.85 while the variance ratio of accessions was only 3.96. Compared to CWR%_dm, the variance ratio of location of ADL%_dm and KL%_dm were lower, which was 305.35 and 820.04 respectively. However, the ADL%_dm and KL%_dm variance ratio of accessions were 16.6 and 29.57, still lower than the variance ratio of locations. Thus, the influence of the locations was not only stronger than the influence of accessions and the interaction between accessions and locations, but it was also more significant on CWR%_dm than on ADL%_dm and KL%_dm.

Table 3.6 ANOVA analysis of CWR%_dm

Source of variation	d.f.	(m.v.)	s.s.	m.s.	v.r.	F pr.
Entry	123		844.952	6.87	3.96	<.001
Location	2		6791.12	3395.56	1959.85	<.001
Entry.Location	227	-19	791.23	3.486	2.01	<.001

Table 3.7 ANOVA analysis of ADL%_dm

Source of variation	d.f.	(m.v.)	s.s.	m.s.	v.r.	F pr.
Entry	123		613.7785	4.9901	16.6	<.001
Location	2		183.6204	91.8102	305.35	<.001
Entry.Location	227	-19	133.6579	0.5888	1.96	<.001

Table 3.8 ANOVA analysis of KL%_dm

Source of variation	d.f.	(m.v.)	s.s.	m.s.	v.r.	F pr.
Entry	123		1376.117	11.1879	29.57	<.001
Location	2		620.5718	310.2859	820.04	<.001
Entry.Location	227	-19	144.8857	0.6383	1.69	<.001

To check the influence differences of the environment between three locations (the Netherlands, France, and Italy) for CWR%_dm, ADL%_dm and KL%_dm, all the prediction data were showed on a graph for each trait. For CWR%_dm, three locations had significantly difference. The data of the samples from the Netherlands had the highest value, followed by Italy, then France. But for KL%_dm and ADL%_dm, the data of the samples from Italy and France were similar, whereas the samples from the Netherlands still had the highest value.

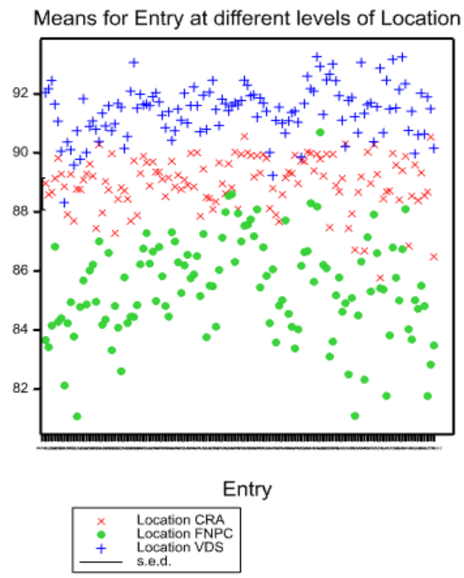

Figure 3.4 Means for entry at different levels of location of CWR%_dm

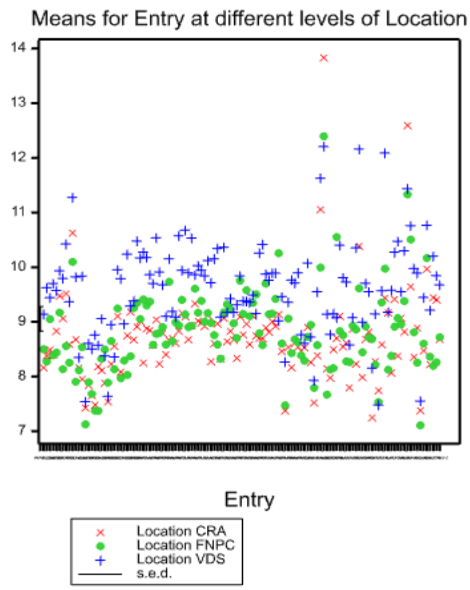

Figure 3.5 Means for entry at different levels of location of ADL%_dm

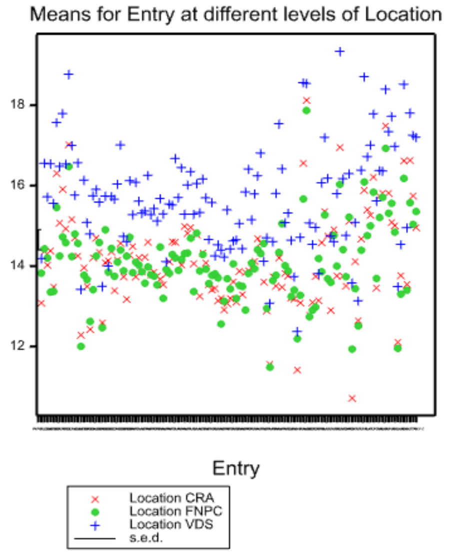

Figure 3.6 Means for entry at different levels of location of KL%_dm

Due to the influence of three locations were different between the cell wall residue and the lignin, the correlations between CWR%_dm, KL%_dm, ADL%_dm were also calculated. The correlation values were shown in Table 3.9 and Table 3.10. It can be seen that CWR%_dm, KL%_dm and ADL%_dm were significantly correlated. ADL%_dm and KL%_dm were strongly correlated with a r^2 of 0.7507. KL%_dm and ADL%_dm were also correlated with CWR%_dm but only with a r^2 of 0.2701 and 0.3237 respectively.

Table 3.9 Correlations between CWR%_dm, KL%_dm and ADL%_dm

	CWR%_dm	*ADL%_dm*	*KL%_dm*
CWR%_dm	1		
ADL%_dm	0.3237	1	
KL%_dm	0.2701	0.7507	1

Table 3.10 Two-sided test of correlations different from zero

CWR%_dm	-		
ADL%_dm	<0.001	-	
KL%_dm	<0.001	<0.001	-
	CWR%_dm	ADL%_dm	KL%_dm

4. Discussion

From biochemical analysis, it can be found out that the variation between the experiment samples was significantly different for each trait. Therefore, it was meaningful to make the prediction models as the second step.

As for prediction models, after RSQ of the calibration samples, R^2 of the validation samples were checked, all the prediction models were proved with good quality. The original data prediction model and other three corrected data prediction models had very similar evaluation values. The reason that we chose original data prediction model as our final prediction model because the original data model is more convenient to use in the further steps which the data do not need correction. Also, the original prediction model is much closer to the real experimental data. However, the original data model may have slightly discrepancy with ideal model.

From the ANOVA analysis result, it proved that genotype (accessions) and environment (locations) had significant influence on data. Also, there was interaction between genotype and environment. The ADL%_dm and KL%_dm data of the samples from the Netherlands was much higher than the samples from France and Italy. The CWR%_dm value of the samples from the Netherlands was the highest, then followed by samples from Italy, the lowest was from France. Also, the analysed results showed that the same accessions cultivated in different places had different CWR%_dm, ADL%_dm and KL%_dm. Almost all the samples had the highest value when grown in the Netherlands, which might be explained by the effects of environment, especially the temperature and the light intensity, among these three locations on the biomass quality (Tang et al., 2016).

Hemp is sensitive to the temperature and the light intensity (Pahkala et al., 2008), and the temperature in the Netherlands is relatively lower than the temperature in France and Italy. As well as light intensity, in the Netherlands the light intensity is quite weak compared to France and Italy. Because of environment differences, the flowering time of hemp in the Netherlands is delayed because of lower temperature and weaker light intensity. The stem growth of the hemp will slow down after flowering (Van der Werf et al., 1994a), which means the harvesting time of hemp, when the maximum yield fibre reached, was delayed according to the flowering time (Amaducci et al., 2002; Mediavilla et al., 2001). Because the samples grown in the Netherlands had a delayed flowering time and a prolonged vegetative growth period, they produced higher yield of fibre (Van der Werf et al., 1994a). Thus, the CWR%_dm values of hemp from the Netherlands were the highest. As a part of cell wall, lignin (KL and ADL) were also produced more when cell wall content increased.

Since the influence of environment was more significant on CWR than lignin, the correlations between CWR%_dm, ADL%_dm and KL%_dm were calculated. Among them, ADL%_dm and KL%_dm were strongly correlated. ADL%_dm and KL%_dm are all lignin means from different methods, but the value of KL%_dm was higher than ADL%_dm. KL molecular composition is similar with ADL, but the amount of ADL%_dm was underestimates due to loss of acid-soluble lignin in the acid detergent step of the procedure and KL could be overestimation (Kondo et al., 1987; Lowry et al., 1994). However, there was only slightly correlation between CWR%_dm and lignin (ADL%_dm and KL%_dm), which means that with the increase of CWR%_dm, the lignin content may also be increased, but mainly caused by other content of cell wall increased, such as cellulose, hemicellulose or pectin.

In conclusion, the plants that were cultivated in a lower temperature and weaker light intensity gave a higher amount of fibres; the plants that cultivated in a higher temperature and stronger light intensity showed lower amount of lignin. Therefore, they might increase the fibre quality as the stiffness of the fibre reduces with the drop of lignin.

However, this thesis had some limits. As we can see from biochemical analysis, CWR had lower RSD which means it had less experimental errors than the other two experiments. The reason why ADL and KL had higher RSDs and even some of their RSDs were reached more than 30 (which should be lower than 15) is possibly that each sample weight was quite low. Because lignin only takes a very small percentage in the cell wall composition, so ADL%_dm and KL%_dm values were relatively small. Thus, even only a small difference may cause big errors on the results. So, to make less or avoid experimental errors, we should weigh enough sample weight. Also, to make sure about the data accuracy, at least three replicates should be included. If the data goes wrong, we need to repeat the experiment again. During the experiment, the procedure must keep the same.

At the end, the final purpose of this project is to determine the hemp cell wall composition and improve the fibre quality. In this thesis, we only analysed the general hemp cell wall residue and lignin, we still need to find out the percentage of cellulose, hemi-cellulose, pectin and their influencing factors with doing more kinds of experiments. At last, we can base on our purpose to choose the hemp we want and where should it grow, like high quality fibre with high cellulose and low lignin. So, there is still a long way to go.

5. Conclusion

In this thesis, 1034 samples of different accessions from three different locations were already scanned by NIRS to help developing the prediction model. Based on the NIRS, 140 samples were selected for CWR, 141 samples for ADL and 140 samples for KL. After finished biochemical analysis, each trait with experimental data was corrected. Biochemical data had large variation of CWR%_dm, ADL%_dm and KL%_dm. Then the biochemical analysed data and NIRS spectrum were integrated together, the prediction model for each trait was developed separately. Also, the validation samples were used to validate the prediction model to exam the models quality. Prediction models with good quality were developed. At last, all the prediction data were put into ANOVA to find out the influencing factors and the correlations between CWR, ADL and KL. The ANOVA analysis indicated that the hemp grown in the Netherlands had the highest CRW%_dm, ADL%_dm and KL%_dm, and the samples from Italy had higher CRW%_dm than the samples from France. But for lignin, no matter the samples were from France or Italy, they had similar data. Also, lignin was strongly correlated with each other but not with CWR%_dm. In conclusion, CWR%_dm, ADL%_dm and KL%_dm was strongly affected by environment, accessions and their interactions. The phenotypic variation had a stronger location influence than the genetic component on all the traits. However, the effect of the location is higher on the CWR%_dm than on the lignin.

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Website:

https://web.archive.org/web/20110219132638/http://www.green.net.au/gf/hemp_cultivation.htm

Appendix

Appendix 1. Biochemical and correction data of CWR%_dm

		AVERAGE	AVERAGE	AVERAGE	AVERAGE
		ORIGINAL DATA	CORRECTED BATCH	CORRECTED CONTROL	DOUBLE CORRECTION
NIRS CODE	**MODEL TYPE**	**CWR%dm**	**CWR%dm**	**CWR%dm**	**CWR%dm**
A701B1VDS	M	91.75739624	90.75105209	91.71435198	90.71714623
A703B1VDS	M	92.38632189	92.71284213	92.3238917	92.65169134
A703B3VDS	M	91.63634087	92.5130608	91.5805772	92.47119072
A705B2CRA	M	89.20048214	89.34099562	89.88793151	90.02664382
CA603B1CRA	M	86.11375789	85.679709	85.58937836	85.16713256
CA604B1VDS	M	88.43943226	88.75085429	88.3766054	88.6892421
CA605B2VDS	M	88.75731164	89.11107256	89.91252982	90.27024183
CR402bisB1VDS	M	86.8893855	86.14920048	87.44906324	86.69929321
CR406B2FNPC	M	86.61891023	86.42218381	87.18160053	86.98253027
CR406B2VDS	M	89.42544245	88.89064845	89.05276466	88.53080956
CR406B3VDS	M	88.62269565	88.86716671	88.86173556	89.1077952
CR407B2VDS	M	90.72187813	89.77630003	89.03536723	88.10437524
CR407B3VDS	M	91.66863661	92.09550455	91.43788452	91.86525503
CR408bisB1VDS	M	91.13436913	90.35729875	91.72201948	90.93488582
CR408bisB3CRA	M	83.32722932	83.17347974	82.32243793	82.17177655
CR409B2VDS	M	90.98571408	91.34191079	91.06573657	91.42280912
CR409B3CRA	M	92.14540761	91.30489477	91.57055551	90.74157743
CR411bisB1CRA	M	90.08907944	90.25671586	90.00065034	90.16757252
CR411bisB3VDS	M	92.98743385	92.81808526	91.88525906	91.7192957
CR412B3VDS	M	90.59524561	90.65491515	90.3346725	90.39836034
CR413bisB3VDS	M	88.34806409	87.96695073	88.42938509	88.048242

CR417bisB2FNPC	M	83.26897837	84.18873762	82.81973766	83.75584201
CR417bisB2VDS	M	88.9027193	89.07039836	88.81281314	88.97978013
CR419B2VDS	M	92.084705	92.39624897	92.25055645	92.5627065
CR420B1CRA	M	88.75923909	87.99937865	89.33422069	88.56451727
CR420B3CRA	M	90.79217209	91.1120107	90.72802558	91.04911234
F203B3CRA	M	91.29640342	91.25517835	91.34850603	91.30726256
F204B1VDS	M	89.67559656	89.45203931	89.23634431	89.01512596
F209B3VDS	M	91.53958893	91.18473033	89.96200397	89.61287114
F211B1VDS	M	91.03068302	91.34250527	91.19476604	91.5071948
F212B2FNPC	M	88.41033507	88.57330663	88.00140083	88.16755412
F214B2VDS	M	92.83681638	92.11744484	93.12576496	92.39576698
F214B3VDS	M	90.5592283	90.62944433	90.31613632	90.39035155
F215B2VDS	M	92.96262519	92.60326463	91.35255448	90.99902193
F216B1CRA	M	89.27411739	88.29391076	89.23003766	88.2587464
F217B1VDS	M	89.92295422	90.97465914	90.36928143	91.43228085
F217B2FNPC	M	85.32804535	84.60583128	85.87360289	85.14204045
F217B2VDS	M	89.40160066	88.46193874	89.47862071	88.53155036
F225B3FNPC	M	87.58649679	87.63059615	86.41158497	86.45819095
F226B2FNPC	M	84.89760293	84.80639227	83.59561539	83.50721506
F227B1VDS	M	90.02101732	90.26967831	90.26415831	90.51443475
F229B3VDS	M	91.87304462	92.12520629	92.11958805	92.37338966
F230B2CRA	M	88.46778663	89.42769406	87.96893299	88.94605487
F233B1FNPC	M	87.33166443	87.46339547	88.010706	88.14063823
F234B3VDS	M	92.75985487	92.94759969	91.7758433	91.96759113
F235B3FNPC	M	87.54844024	86.60256763	87.53605546	86.5985854
F236B1CRA	M	88.78640829	88.95049092	88.37618189	88.54345868
F237B2CRA	M	90.31647529	89.96866215	88.74188932	88.39975548
F239B1VDS	M	92.04571405	92.10873729	91.78491198	91.85201388
F241B2VDS	M	92.046279	91.87842742	90.95339666	90.78890199

F241B3VDS	M	92.23881086	91.45466066	92.83154935	92.03724615
F244B1VDS	M	89.42132684	88.86996243	89.03470894	88.49633247
F244B3VDS	M	89.09060492	89.23555218	89.77247735	89.91565359
F246B1CRA	M	85.78921495	86.22482082	85.88310599	86.31956822
F251B1FNPC	M	84.65665718	85.3129618	84.83498024	85.49267538
F251B3VDS	M	90.77352442	90.8195418	89.55669528	89.60530673
F252B1CRA	M	91.54885791	90.8383056	91.83516177	91.11411639
F252B2VDS	M	91.14292603	91.28452193	91.84737573	91.98711926
F255B2FNPC	M	87.39895401	87.56294602	87.31156737	87.47486209
I901B2VDS	M	91.33056396	92.31957743	92.52263649	93.52402085
I901B3VDS	M	94.02652513	94.05863611	93.76042521	93.79213697
I902B1VDS	M	93.15096396	93.01447506	93.43586388	93.29650286
I902B3CRA	M	88.20201053	88.20380086	88.64198632	88.64069521
L501B1CRA	M	86.9688769	87.64275655	87.15195835	87.82726489
L501B3CRA	M	88.44448211	88.83655385	89.59496723	89.99148765
V301B1CRA	M	88.23430854	87.89337248	86.70498049	86.36957792
V301B1FNPC	M	88.27266231	89.25587073	87.80663762	88.80724488
V301B2VDS	M	91.96616308	91.40933165	91.57714154	91.03357549
V302B2FNPC	M	85.32913009	85.61598895	85.48275241	85.77016938
V303B1VDS	M	93.77422393	93.30846496	93.20752886	92.7545618
WU101B1CRA	M	89.91342298	90.47224761	89.84905847	90.40803672
WU103B3VDS	M	89.64012573	90.33483612	89.82887292	90.52505464
WU105B2FNPC	M	82.53473533	81.77693243	82.01534479	81.26794509
WU106B3VDS	M	93.05053646	92.0731316	93.12942177	92.14432015
WU110B3CRA	M	82.25728172	82.41033283	82.17655424	82.32895323
WU111B1CRA	M	89.45104688	88.68858692	90.02761901	89.25528519
WU111B1VDS	M	90.4070515	91.36653826	91.58759778	92.5590811
WU113B1CRA	M	91.08074347	90.94799831	91.35642331	91.22087632
WU115B1VDS	M	95.37734203	94.79294523	95.83670382	95.2411127

WU116B3CRA	M	88.40091867	89.23765391	88.34016596	89.19024146
WU116B3FNPC	M	88.70831269	88.76415751	88.44892214	88.50870584
WU117B2FNPC	M	81.38856632	82.01893075	81.55981214	82.19151064
WU118B2FNPC	M	82.63280226	83.01771025	82.42494947	82.81031092
WU120B3VDS	M	92.47300607	91.90336826	92.9208878	92.34036641
WU121B1VDS	M	91.98399948	92.30066475	92.14985417	92.46713533
WU122B2VDS	M	92.97707265	92.93509876	93.03035311	92.98836039
WU122B3CRA	M	91.38450399	90.82592686	90.99351267	90.44816451
WU123B1FNPC	M	94.10387626	94.29217568	93.10036238	93.29273506
WU124B1VDS	M	91.21861955	91.52886818	91.38296637	91.69381852
WU124B3VDS	M	89.21865672	90.24427267	89.65344448	90.69008305
WU125B1FNPC	M	84.2940766	84.59242971	84.23827021	84.53779446
WU126B1CRA	M	90.84487117	89.85374315	90.81269474	89.83049898
WU126B3VDS	M	91.61648762	91.02898466	92.07933437	91.48081904
WU127B3VDS	M	90.18327492	89.95747778	89.73847603	89.5150435
WU128B1VDS	M	91.12978616	90.70061062	91.82970869	91.39107486
WU128B2FNPC	M	92.03137544	91.07306367	90.31995645	89.37643022
WU128B3VDS	M	93.25415077	93.28579893	92.99144452	93.02269769
WU131B3CRA	M	89.62906859	90.08404655	89.72651094	90.18238014
WU131bisB3VDS	M	92.58102924	92.13772966	92.03192189	91.60110492
CA602B3VDS	O	89.54563674	90.23957148	89.73417111	90.42957543
CR405bisB3VDS	O	90.94558157	90.38948672	90.55629949	90.01337189
CR412B3FNPC	O	86.60311235	87.52041149	87.73403543	88.66280317
F240B1VDS	O	92.03151147	92.09312123	91.76844185	91.83413197
U801B2VDS	O	93.70104044	92.67268025	93.65568276	92.63667001
U801B3VDS	O	93.20757162	93.78915566	93.14414429	93.72590649
V301B2FNPC	O	83.28145948	84.32157168	83.41439242	84.4646338
V301B3FNPC	O	86.23812402	86.90671115	86.4197854	87.08978912
V303B1CRA	O	88.96204424	88.42736112	88.58906013	88.06717336

V303B2CRA	O	87.0906403	88.29276906	87.37090324	88.58301772
V303B2FNPC	O	82.89813307	82.81198884	81.63781648	81.55436077
WU111B3FNPC	O	86.74187488	86.91008157	86.34955533	86.5208617
WU115B2VDS	O	92.46944201	92.23617999	92.00789973	91.77708451
WU119B3VDS	O	91.99795872	91.41587027	92.45624014	91.86317145
WU122B1VDS	O	94.00047404	93.26885576	94.29683931	93.5544223
WU122B3VDS	O	92.65524731	92.44742749	93.24675351	93.03646693
WU130B3VDS	O	91.09449363	91.52546581	90.87412766	91.30562428
A702B1VDS	V	92.02515117	92.07289675	90.79445617	90.84481845
A704B1CRA	V	90.24880597	89.69099417	90.68746384	90.11901163
CA602B2VDS	V	88.5938078	88.77017135	87.64684804	87.82705148
CR401bisB3CRA	V	87.36227414	88.73206277	88.1710513	89.55639306
CR407B2CRA	V	87.56877567	87.73330072	87.16705795	87.33472622
CR413bisB2FNPC	V	82.71036875	82.75149973	81.59950003	81.64300425
CR416B2CRA	V	89.5903531	89.38722948	90.17094965	89.9654072
F212B3VDS	V	90.9663958	90.83026782	91.25616181	91.11720321
F218B3FNPC	V	88.54802762	87.99673226	88.98171906	88.41994418
F219B2CRA	V	91.22837722	91.409217	90.25139628	90.43619449
F228B1CRA	V	90.48976352	89.92348597	90.93535472	90.35833914
F230B3CRA	V	89.93216846	90.28582933	90.01177227	90.36630221
F231B2CRA	V	90.6378435	91.20218426	90.57442187	91.13892588
F239B3CRA	V	88.11913483	89.4932624	88.6668698	90.05270803
F241B1VDS	V	91.92479614	90.91633971	91.88111944	90.8818242
F244B1FNPC	V	87.5219055	87.55081696	87.28014917	87.30869373
I903B1CRA	V	90.3814324	91.50135564	90.51883453	91.64965009
L501B2FNPC	V	87.25858852	86.45787718	86.70989192	85.92017251
WU101B3CRA	V	90.98389617	89.42698761	90.94742686	89.39194258
WU104B1CRA	V	90.27319088	90.41574301	90.96854919	91.10928061
WU119B2CRA	V	90.47912131	90.43830019	90.53151355	90.49067388

WU121B2VDS	V	90.73783362	90.29514085	90.19449986	89.76411403
WU127B1CRA	V	86.9830674	88.06572499	87.11905497	88.2122502
WU129B3CRA	V	85.09801287	85.15773614	84.85929186	84.92278351

Appendix 2. Biochemical and correction data of ADL%_dm

		AVERAGE	**AVERAGE**	**AVERAGE**	**AVERAGE**
		ORIGINAL DATA	**CORRECTED BATCH**	**CORRECTED CONTROL**	**DOUBLE CORRECTION**
NIRS CODE	**MODEL TYPE**	**ADL%dm**	**ADL%dm**	**ADL%dm**	**ADL%dm**
A701B1VDS	M	10.36968091	10.30751814	11.02527979	10.94081152
A703B1VDS	M	9.828406889	9.828406889	9.828406889	9.828406889
A703B3VDS	M	8.647812862	9.112830705	8.347649871	8.793831371
A705B2CRA	M	7.963281898	8.100439944	8.384540331	8.531738326
CA603B1CRA	M	9.472075175	9.5744074	9.417040596	9.519019252
CA604B1VDS	M	8.550011644	8.550011644	8.550011644	8.550011644
CA605B2VDS	M	10.487049	10.55046069	11.304328	11.35956591
CR402bisB1VDS	M	7.658748095	7.658748095	7.658748095	7.658748095
CR406B2FNPC	M	8.21498848	8.034528404	6.882089837	6.730909777
CR406B2VDS	M	7.895325909	7.895325909	7.895325909	7.895325909
CR406B3VDS	M	8.082661205	8.30432879	7.861168217	8.074533046
CR407B2VDS	M	7.210467424	7.460575535	6.867996595	7.128553977
CR407B3VDS	M	9.089653913	9.353922035	8.843259336	9.097872107
CR408bisB1VDS	M	10.5855121	10.32369143	11.42758806	11.12904402
CR408bisB3CRA	M	7.536071901	7.536071901	7.536071901	7.536071901
CR409B2VDS	M	8.850358199	8.788442383	9.167074978	9.101103598
CR409B3CRA	M	7.689759724	7.352175521	7.95008802	7.601695037
CR411bisB1CRA	M	8.061121484	8.177732639	7.840261434	7.958403718

CR411bisB3VDS	M	7.975566386	7.975566386	7.975566386	7.975566386
CR412B3VDS	M	8.207378859	8.207378859	8.207378859	8.207378859
CR413bisB3VDS	M	9.685644821	9.804893138	9.637871888	9.756542498
CR417bisB2FNPC	M	7.483895231	7.785647503	7.488899451	7.786506681
CR417bisB2VDS	M	9.392498159	8.988556619	9.132892037	8.745771223
CR419B2VDS	M	9.466381665	9.238004161	10.18472931	9.928035754
CR420B1CRA	M	7.902062139	7.902062139	7.902062139	7.902062139
CR420B3CRA	M	8.018003083	7.97339658	7.297616012	7.277440904
F203B3CRA	M	8.373909047	8.271218046	8.183524381	8.086582545
F204B1VDS	M	9.700354305	9.700354305	9.700354305	9.700354305
F209B3VDS	M	10.00913477	10.00913477	10.00913477	10.00913477
F211B1VDS	M	11.18877901	10.98888452	11.90873294	11.68100893
F212B2FNPC	M	8.483741651	8.125604728	8.781073211	8.392542791
F214B2VDS	M	12.3891279	12.21424739	11.98827058	11.82459716
F214B3VDS	M	10.09735588	10.20059941	10.47988021	10.59023686
F215B2VDS	M	9.615401373	9.328898189	10.29035716	9.976225062
F216B1CRA	M	8.26056441	8.26056441	8.26056441	8.26056441
F217B1VDS	M	10.73076341	10.49588031	10.74890754	10.50080198
F217B2FNPC	M	9.429752026	9.516952925	9.36422211	9.451260904
F217B2VDS	M	10.65608048	10.65608048	10.65608048	10.65608048
F225B3FNPC	M	8.253668457	8.684149452	8.556566245	8.995916172
F226B2FNPC	M	8.298212364	8.516260308	8.142304269	8.370481951
F227B1VDS	M	8.433846169	8.610572111	7.776887407	7.954559013
F229B3VDS	M	7.65848201	7.995768887	8.092690405	8.45438833
F230B2CRA	M	8.31624925	8.725031715	8.458769014	8.868919049
F233B1FNPC	M	9.81098863	9.658751768	9.243056936	9.120934798
F234B3VDS	M	10.19003421	10.19003421	10.19003421	10.19003421
F235B3FNPC	M	9.59787743	9.443244086	9.366397544	9.221941957
F236B1CRA	M	8.15550901	8.15550901	8.15550901	8.15550901

F237B2CRA	M	9.290943667	9.342129133	9.85632422	9.897811717
F239B1VDS	M	10.04025659	9.868700256	9.411513819	9.271188267
F241B2VDS	M	9.228511758	9.662992055	9.25446537	9.689827337
F241B3VDS	M	9.327772675	9.233045136	10.01881302	9.908015599
F244B1VDS	M	10.04079171	9.61333568	10.42766652	9.962971946
F244B3VDS	M	10.13507675	10.13507675	10.13507675	10.13507675
F246B1CRA	M	8.217956779	8.421900791	8.109579238	8.303614492
F251B1FNPC	M	8.564697579	8.594677022	8.309748913	8.341042552
F251B3VDS	M	9.740260017	9.510239641	10.20186902	9.959627004
F252B1CRA	M	9.33431503	9.810560529	9.136184162	9.590646466
F252B2VDS	M	9.314197985	9.428853392	9.258837031	9.372820687
F255B2FNPC	M	8.585378283	8.632851177	8.52037134	8.565615698
I901B2VDS	M	9.146040023	8.914838801	9.001381702	8.777099913
I901B3VDS	M	9.07578686	9.07578686	9.07578686	9.07578686
I902B1VDS	M	7.282454738	7.202968264	7.544034163	7.44429629
I902B3CRA	M	7.770493346	7.770493346	7.770493346	7.770493346
L501B1CRA	M	10.63187741	10.42583151	9.70621843	9.524754376
L501B3CRA	M	10.06919921	10.06919921	10.06919921	10.06919921
V301B1CRA	M	7.555946615	7.555946615	7.555946615	7.555946615
V301B1FNPC	M	7.470492596	7.433394891	7.4919412	7.470112051
V301B2VDS	M	7.563241427	7.681285591	8.0630754	8.190833154
V302B2FNPC	M	7.68161985	7.611910886	7.384684208	7.323222941
V303B1VDS	M	9.735115722	9.940966413	9.697786737	9.886593869
WU101B1CRA	M	10.13063776	10.12882263	9.96348464	9.956287633
WU103B3VDS	M	10.28004632	10.07020715	9.98912727	9.785260927
WU105B2FNPC	M	8.833135121	8.987146257	8.339424592	8.492081395
WU106B3VDS	M	10.62622366	10.62622366	10.62622366	10.62622366
WU110B3CRA	M	8.578353774	8.578353774	8.578353774	8.578353774
WU111B1CRA	M	6.548713933	6.548713933	6.548713933	6.548713933

WU111B1VDS	M	7.468509464	7.468509464	7.468509464	7.468509464
WU113B1CRA	M	7.724190168	7.719199802	8.00772022	8.000418183
WU115B1VDS	M	11.51334052	11.51334052	11.51334052	11.51334052
WU116B3CRA	M	8.956217312	8.965177034	8.868298859	8.899539169
WU116B3FNPC	M	7.921839746	7.921839746	7.921839746	7.921839746
WU117B2FNPC	M	8.824458813	8.824458813	8.824458813	8.824458813
WU118B2FNPC	M	9.431198708	9.254820642	9.579648529	9.414663725
WU120B3VDS	M	10.09105155	9.988376449	10.28004214	10.17026692
WU121B1VDS	M	11.70970198	11.59761471	11.45132273	11.35377231
WU122B2VDS	M	11.68455232	11.74363455	12.06853816	12.12797105
WU122B3CRA	M	11.34709543	11.21156595	12.23816737	12.07982069
WU123B1FNPC	M	10.57432182	10.57432182	10.57432182	10.57432182
WU124B1VDS	M	10.51096789	10.52471278	10.4039914	10.44286768
WU124B3VDS	M	10.12016258	10.37468277	10.55060826	10.82025159
WU125B1FNPC	M	7.47730246	7.47730246	7.47730246	7.47730246
WU126B1CRA	M	7.210436105	7.336596825	7.604474018	7.708691857
WU126B3VDS	M	8.408668013	8.487848579	8.733651515	8.817344487
WU127B3VDS	M	8.95364073	8.95364073	8.95364073	8.95364073
WU128B1VDS	M	8.810487553	8.734511629	8.345827972	8.279099204
WU128B2FNPC	M	10.84310376	10.84310376	10.84310376	10.84310376
WU128B3VDS	M	11.53860188	11.16438073	11.71191855	11.32278588
WU131B3CRA	M	9.417201439	9.617185742	9.639926588	9.848165579
WU131bisB3VDS	M	9.942235601	9.942235601	9.942235601	9.942235601
CA602B3VDS	O	9.543117589	9.512046195	10.15763109	10.10905617
CR405bisB3VDS	O	7.439105343	7.439105343	7.439105343	7.439105343
CR412B3FNPC	O	8.378899061	8.085374719	8.504314457	8.194599669
F240B1VDS	O	10.283893	10.283893	10.283893	10.283893
U801B2VDS	O	13.33943357	13.32053604	13.20603195	13.21148735
U801B3VDS	O	12.03291617	12.03291617	12.03291617	12.03291617

V301B2FNPC	O	8.467679151	8.518206853	8.243599848	8.310855992
V301B3FNPC	O	6.673879777	6.673879777	6.673879777	6.673879777
V303B1CRA	O	8.794193744	8.998719529	9.2455424	9.461915169
V303B2CRA	O	8.635914268	8.830384837	9.10268607	9.312750074
V303B2FNPC	O	8.676975983	8.525616076	8.47951162	8.337223093
WU111B3FNPC	O	8.028022286	8.24279309	8.052380669	8.258432662
WU115B2VDS	O	14.12648623	13.96301959	13.44748498	13.32603418
WU119B3VDS	O	10.38192895	10.38192895	10.38192895	10.38192895
WU122B1VDS	O	11.78929406	11.25837761	13.10530935	12.51015839
WU122B3VDS	O	10.56524962	10.6843484	10.08078797	10.20111621
WU130B3VDS	O	10.23494199	10.23494199	10.23494199	10.23494199
A702B1VDS	V	9.250530782	9.250530782	9.250530782	9.250530782
A704B1CRA	V	7.758423842	7.758423842	7.758423842	7.758423842
CA602B2VDS	V	9.268507025	9.268507025	9.268507025	9.268507025
CR401BisB3CRA	V	8.07060635	8.07060635	8.07060635	8.07060635
CR407B2CRA	V	7.555220871	7.555220871	7.555220871	7.555220871
CR413BisB2FNPC	V	8.657286944	8.657286944	8.657286944	8.657286944
CR416B2CRA	V	7.758319827	7.758319827	7.758319827	7.758319827
F212B3VDS	V	8.939026904	8.939026904	8.939026904	8.939026904
F218B3FNPC	V	8.959000342	8.959000342	8.959000342	8.959000342
F219B2CRA	V	8.931848303	8.931848303	8.931848303	8.931848303
F228B1CRA	V	8.196920169	8.196920169	8.196920169	8.196920169
F230B3CRA	V	8.509920064	8.509920064	8.509920064	8.509920064
F231B2CRA	V	7.680629955	7.680629955	7.680629955	7.680629955
F239B3CRA	V	9.109846033	9.109846033	9.109846033	9.109846033
F241B1VDS	V	10.49547775	10.49547775	10.49547775	10.49547775
F244B1FNPC	V	10.42663098	10.42663098	10.42663098	10.42663098
I903B1CRA	V	7.693530393	7.693530393	7.693530393	7.693530393
L501B2FNPC	V	10.24622136	10.24622136	10.24622136	10.24622136

U801B3FNPC	V	12.63814202	12.63814202	12.63814202	12.63814202
WU101B3CRA	V	9.408947271	9.408947271	9.408947271	9.408947271
WU104B1CRA	V	8.024076981	8.024076981	8.024076981	8.024076981
WU119B2CRA	V	8.588868257	8.588868257	8.588868257	8.588868257
WU121B2VDS	V	9.726004058	9.726004058	9.726004058	9.726004058
WU127B1CRA	V	7.153451458	7.153451458	7.153451458	7.153451458
WU129B3CRA	V	6.838124892	6.838124892	6.838124892	6.838124892

Appendix 3. Biochemical and correction data of KL%_dm

		AVERAGE	**AVERAGE**	**AVERAGE**	**AVERAGE**
		ORIGINAL DATA	**CORRECTED BATCH**	**CORRECTED CONTROL**	**DOUBLE CORRECTION**
NIRS CODE	**MODEL TYPE**	**KL%dm**	**KL%dm**	**KL%dm**	**KL%dm**
A701B1VDS	M	12.45068023	13.20886215	13.50917599	14.37850801
A703B1VDS	M	15.37023057	15.99709412	15.85622279	16.54884907
A703B3VDS	M	17.04108378	16.38201561	17.86538627	17.28550833
A705B2CRA	M	13.40168958	13.95015533	13.90728689	14.51393987
CA603B1CRA	M	15.53124234	14.95362669	15.3055922	14.76072331
CA604B1VDS	M	13.85731489	14.44031727	15.76256923	16.42297464
CA605B2VDS	M	19.50595453	20.1164662	21.72011674	22.40531531
CR402bisB1VDS	M	15.29861896	14.64233143	14.56632088	13.95658874
CR406B2FNPC	M	14.16915099	14.00659394	14.1528111	14.02816237
CR406B2VDS	M	15.31025676	15.87754427	16.64728315	17.31459647
CR406B3VDS	M	14.87095489	15.76126706	16.04155643	17.03269451
CR407B2VDS	M	13.106679	13.01113879	12.8633603	12.79433405
CR407B3VDS	M	14.50729271	14.73939741	15.33999241	15.67201345
CR408bisB1VDS	M	14.39310986	14.87881789	15.90725726	16.45398354

CR408bisB3CRA	M	11.15347813	11.71110497	12.26498037	12.90551902
CR409B2VDS	M	16.31117728	16.92483994	16.98087756	17.6735895
CR409B3CRA	M	14.43173102	14.1400684	14.58013047	14.37180127
CR411bisB1CRA	M	13.32696849	13.50841834	13.95414856	14.16995004
CR411bisB3VDS	M	15.5693744	15.18378306	15.02644362	14.66082081
CR412B3VDS	M	12.93518841	13.70904425	14.97621411	15.87494251
CR413bisB3VDS	M	17.17734045	17.9148608	18.95205288	19.78958654
CR417bisB2FNPC	M	14.54997203	14.91291399	15.31768627	15.72102056
CR417bisB2VDS	M	16.52888757	16.15102561	15.94479772	15.64948864
CR419B2VDS	M	14.58939207	14.24803858	14.207175	13.88490521
CR420B1CRA	M	11.72802379	12.17806122	12.90843653	13.40635764
CR420B3CRA	M	13.01678882	13.4713138	14.17036489	14.66167234
F203B3CRA	M	12.21886676	12.69457163	13.03421915	13.57090051
F204B1VDS	M	14.6596302	14.25194211	14.07252097	13.73060781
F209B3VDS	M	17.32813783	16.64191905	18.14466985	17.53883396
F211B1VDS	M	15.92920533	16.81958691	17.40957067	18.39951298
F212B2FNPC	M	12.6672478	11.9168063	11.90051431	11.19281584
F214B2VDS	M	17.65879481	17.01894391	17.03987329	16.46448399
F214B3VDS	M	14.90005994	15.72647432	16.84477204	17.77829597
F215B2VDS	M	14.51938791	15.09293674	15.49717752	16.22598757
F216B1CRA	M	13.73965343	14.37090895	15.49863383	16.20805236
F217B1VDS	M	16.96482055	16.37609295	16.19941049	15.67882678
F217B2FNPC	M	15.55234998	14.98498651	14.81945478	14.31856753
F217B2VDS	M	15.60852035	16.26263161	17.75551636	18.49650156
F225B3FNPC	M	13.13557532	14.30053745	15.14434146	16.48644192
F226B2FNPC	M	12.93133653	12.55267876	12.26944493	11.94106847
F227B1VDS	M	13.79248844	14.33098143	14.86104605	15.46956179
F229B3VDS	M	14.93658669	14.72828409	15.12199242	15.01461551
F230B2CRA	M	13.30402845	13.20204503	13.81027325	13.7581362

F233B1FNPC	M	13.98470332	13.74383755	14.06248756	13.92082475
F234B3VDS	M	13.20949102	13.05984151	12.95843773	12.8382282
F235B3FNPC	M	13.22608922	12.4188802	12.49188272	11.78106129
F236B1CRA	M	13.20625162	13.40521717	14.21075645	14.44638158
F237B2CRA	M	15.50341814	15.11002379	15.53451076	15.25528254
F239B1VDS	M	16.12585271	16.20887522	16.35711086	16.50387095
F241B2VDS	M	15.34509055	14.37237183	15.06093133	14.10622534
F241B3VDS	M	14.90506538	15.21302205	15.44156497	15.74944109
F244B1VDS	M	17.60243979	16.48662867	17.27647915	16.18133054
F244B3VDS	M	17.19801169	16.95945972	17.3303486	17.18441245
F246B1CRA	M	11.36992557	11.23423683	11.26066675	11.2098939
F251B1FNPC	M	14.83528823	15.10008121	15.13533259	15.48563703
F251B3VDS	M	16.06018009	16.61538068	17.37209551	18.02623827
F252B1CRA	M	14.23511144	13.76555434	15.03296972	14.63027634
F252B2VDS	M	17.20129367	17.52455828	18.01281457	18.37769846
F255B2FNPC	M	14.32161418	13.80146749	14.20461678	13.75610719
I901B2VDS	M	15.09440406	15.18972203	16.1518183	16.26702124
I901B3VDS	M	14.25305566	13.89099252	13.74907751	13.40617938
I902B1VDS	M	11.59681559	11.7806199	11.46150551	11.64948118
I902B3CRA	M	11.83580432	9.709135109	12.46465512	12.84316204
L501B1CRA	M	16.88237707	17.41038922	17.43439434	18.00924188
L501B3CRA	M	16.23207634	15.66455274	15.33398432	14.88630593
V301B1CRA	M	13.43036129	13.30947155	13.88249614	13.86178676
V301B1FNPC	M	13.12752521	13.63324669	14.51081183	15.07611331
V301B2VDS	M	14.04768418	14.30068098	14.75012189	15.04144288
V302B2FNPC	M	10.92342907	11.28275041	11.878478	12.28695105
V303B1VDS	M	15.03266027	14.59859609	15.26046914	14.87514717
WU101B1CRA	M	13.89617603	13.90729063	13.55256388	13.59299997
WU103B3VDS	M	16.90724407	17.31099783	18.14545729	18.59866811

WU105B2FNPC	M	13.29439832	13.58824688	14.54463446	14.88394294
WU106B3VDS	M	16.17529938	16.47948054	16.43795582	16.84369565
WU110B3CRA	M	15.55424465	15.85000984	17.11872324	17.45669541
WU111B1CRA	M	11.75885808	12.04606188	12.5425975	12.87403495
WU111B1VDS	M	12.04228024	12.08883633	12.66942122	12.73483953
WU113B1CRA	M	12.24141205	12.42576535	13.02146139	13.23316873
WU115B1VDS	M	16.51152564	17.9833139	19.01769329	20.711603
WU116B3CRA	M	15.6229049	16.10168702	16.59420896	17.1029205
WU116B3FNPC	M	15.81150059	16.67515077	17.88361486	18.85945233
WU117B2FNPC	M	14.92999946	15.19167817	15.66360601	15.96516596
WU118B2FNPC	M	16.57667702	17.03213696	19.01696249	19.53965595
WU120B3VDS	M	18.03634592	17.36796163	17.78344607	17.15271815
WU121B1VDS	M	16.95905491	16.78709213	17.50143139	17.45676751
WU122B2VDS	M	18.37903624	19.2177696	19.87383779	20.79716574
WU122B3CRA	M	16.31017234	16.89078032	17.83649797	18.49684946
WU123B1FNPC	M	15.45678315	15.88481977	16.57139987	17.02042817
WU124B1VDS	M	17.9580486	17.3059058	17.32241573	16.73599249
WU124B3VDS	M	18.85581459	17.54946197	17.39946161	16.20546656
WU125B1FNPC	M	14.30836332	14.6987701	14.82085935	15.25694699
WU126B1CRA	M	11.60762882	11.40568465	11.68095032	11.51270153
WU126B3VDS	M	13.00707936	13.52370453	14.39053656	14.98901705
WU127B3VDS	M	14.27359205	14.60964169	15.81281605	16.1961818
WU128B1VDS	M	16.84794321	17.87880628	18.26338698	19.44408698
WU128B2FNPC	M	15.9101721	14.90163311	15.61554874	14.6256858
WU128B3VDS	M	17.21242164	17.46443598	17.6611201	17.91311987
WU131B3CRA	M	15.41865008	15.44848667	15.42640664	15.55246869
WU131bisB3VDS	M	16.83368137	16.60912188	16.23356323	16.0468969
CA602B3VDS	O	17.80597395	16.05058407	16.14737974	14.55094356
CR405bisB3VDS	O	12.21951863	12.39038261	12.77560903	12.97856463

CR412B3FNPC	O	13.93372318	12.88754518	12.92572653	11.94652506
F240B1VDS	O	15.38172383	15.45689449	15.61672078	15.75667421
U801B2VDS	O	20.53332983	19.03062793	19.00440385	17.60137146
U801B3VDS	O	18.62571468	17.26161944	17.23891716	15.9652256
V301B2FNPC	O	12.82862748	12.89966031	13.69241866	13.77888543
V301B3FNPC	O	13.5174646	13.15201105	13.19499458	12.90911938
V303B1CRA	O	13.27670085	13.76967807	14.58685249	15.13162706
V303B2CRA	O	14.6881317	15.14112301	15.1461471	15.63910863
V303B2FNPC	O	12.80809116	13.27920431	13.75577139	14.29587782
WU111B3FNPC	O	9.817412292	9.677070436	9.566762998	9.456512956
WU115B2VDS	O	20.47576899	19.66105165	19.5919082	18.86525276
WU119B3VDS	O	15.04923332	15.36444989	15.43924328	15.76515933
WU122B1VDS	O	19.88309057	19.8360953	20.51386955	20.55024053
WU122B3VDS	O	19.12736605	19.49748471	20.08645179	20.47400552
WU130B3VDS	O	17.71279687	17.28697078	17.0564194	16.72067183
A702B1VDS	V	17.03441345	17.15576663	18.28393254	18.42986113
A704B1CRA	V	15.00291878	14.4527555	15.76921911	15.28903943
CA602B2VDS	V	17.43887988	17.01472495	16.93824198	16.70434072
CR401bisB3CRA	V	14.64111743	15.09664943	15.79122197	16.3021265
CR407B2CRA	V	14.38370916	13.93623078	14.08023734	13.70293699
CR413bisB2FNPC	V	11.68458244	11.60076217	11.55045892	11.48933824
CR416B2CRA	V	13.67717323	13.32800883	13.53408511	13.20606568
F212B3VDS	V	14.21790767	14.04302307	14.00382426	13.84811515
F218B3FNPC	V	15.09852587	14.69002221	14.85630178	14.46942272
F219B2CRA	V	15.84127754	14.73685333	14.86487174	13.85690104
F228B1CRA	V	13.19940958	12.65909295	12.55087694	12.05082708
F230B3CRA	V	13.67242211	14.01305171	14.32661424	14.71549124
F231B2CRA	V	13.01793755	13.48113139	14.77445831	15.29756996
F239B3CRA	V	15.02528122	15.2660182	16.00896117	16.28516349

F241B1VDS	V	16.4617076	15.76712603	16.02971841	15.37026533
F244B1FNPC	V	14.60402502	14.94093642	15.28997464	15.65774027
I903B1CRA	V	13.28228917	13.56883304	13.96740282	14.29658383
L501B2FNPC	V	14.85036369	14.63257093	14.36134436	14.1577864
WU101B3CRA	V	14.46448483	14.94078081	15.57549012	16.11540108
WU104B1CRA	V	13.96657054	13.21185404	13.54383584	12.89668065
WU119B2CRA	V	14.18189237	13.83970067	13.45769373	13.18483
WU121B2VDS	V	16.79979	16.51479956	16.78922333	16.53544682
WU127B1CRA	V	12.71225908	12.57147057	12.47350783	12.44793918
WU129B3CRA	V	13.49120664	13.68353024	13.85940461	14.05183649

Appendix 4. Prediction results

NIRS_CODE!	**BLOCK!**	**LOCATION!**	**KL%dm_ORI**	**ADL%dm_ORI**	**CWR_ORI**
A701	B1	CRA	13.188	8.245	89.163
A701	B1	FNPC	14.114	8.899	83.931
A701	B1	VDS	14.16	10.033	91.315
A701	B2	CRA	11.871	7.354	88.889
A701	B2	FNPC	13.854	8.504	83.691
A701	B2	VDS	14.63	8.749	91.822
A701	B3	CRA	14.185	8.893	88.864
A701	B3	FNPC	13.535	8.101	83.381
A701	B3	VDS	13.777	8.642	93.008
A702	B1	CRA	14.083	7.814	87.761
A702	B1	FNPC	14.567	7.749	81.886
A702	B1	VDS	17.045	10.043	92.106
A702	B2	CRA	14.784	8.818	88.418
A702	B2	FNPC	14.895	8.822	84.032

A702	B2	VDS	15.978	9.057	91.967
A702	B3	CRA	14.223	8.517	89.599
A702	B3	FNPC	13.823	8.253	84.339
A702	B3	VDS	16.654	9.772	92.463
A703	B1	CRA	13.097	8.224	87.531
A703	B1	FNPC	14.961	9.419	81.952
A703	B1	VDS	16.415	10.102	93.623
A703	B2	CRA	14.837	8.759	89.829
A703	B2	FNPC	14.171	9.306	84.839
A703	B2	VDS	14.821	9.157	91.644
A703	B3	CRA	14.136	8.492	88.663
A703	B3	FNPC	13.473	8.43	85.653
A703	B3	VDS	15.929	9.073	92.108
A704	B1	CRA	14.389	8.275	89.202
A704	B1	FNPC	13.58	8.054	85.872
A704	B1	VDS	15.929	9.151	91.86
A704	B2	CRA	14.241	8.663	89.652
A704	B2	FNPC	13.1	8.69	87.715
A704	B2	VDS	16.369	9.686	91.587
A704	B3	CRA	14.504	8.26	88.563
A704	B3	FNPC	13.379	8.426	86.887
A704	B3	VDS	17.341	10.269	91.527
A705	B1	CRA	12.905	8.165	89.723
A705	B1	FNPC	13.586	8.452	84.408
A705	B1	VDS	15.353	9.093	90.438
A705	B2	CRA	12.963	8.573	89.676
A705	B2	FNPC	13.456	8.242	83.165
A705	B2	VDS	15.764	9.118	91.002
A705	B3	CRA	14.577	9.759	90.091

A705	B3	FNPC	13.061	8.623	85.254
A705	B3	VDS	15.571	10.509	91.781
CA601	B1	CRA	16.89	9.7	89.437
CA601	B1	FNPC	15.847	9.245	83.104
CA601	B1	VDS	18.326	10.016	90.739
CA601	B2	CRA	15.876	9.557	89.568
CA601	B2	FNPC	15.143	8.961	84.47
CA601	B2	VDS	16.102	8.999	88.726
CA601	B3	CRA	16.154	9.168	88.87
CA601	B3	FNPC	15.377	9.303	85.63
CA601	B3	VDS	18.291	10.791	90.722
CA602	B1	CRA	15.242	8.962	88.336
CA602	B1	FNPC	14.637	8.611	82.206
CA602	B1	VDS	15.441	10.1	85.11
CA602	B2	CRA	15.443	9.142	88.985
CA602	B2	FNPC	14.345	8.202	81.981
CA602	B2	VDS	17.332	9.597	90.063
CA602	B3	CRA	14.528	9.086	89.27
CA602	B3	FNPC	13.764	7.595	82.171
CA602	B3	VDS	16.655	9.692	89.79
CA603	B1	CRA	15.253	9.086	85.178
CA603	B1	FNPC	15.11	8.591	83.862
CA603	B1	VDS	17.906	10.332	90.629
CA603	B2	CRA	16.321	9.919	89.432
CA603	B2	FNPC	14.768	8.254	84.046
CA603	B2	VDS	17.071	9.904	90.26
CA603	B3	CRA	16.157	9.55	89.141
CA603	B3	FNPC	14.296	8.827	84.787
CA603	B3	VDS	18.407	11.039	90.225

CA604	B1	CRA	14.779	8.398	88.124
CA604	B1	FNPC	14.588	8.232	84.759
CA604	B1	VDS	14.983	8.668	88.842
CA604	B2	CRA	15.11	8.812	89.972
CA604	B2	FNPC	14.767	8.082	84.062
CA604	B2	VDS	18	9.926	90.513
CA604	B3	CRA	14.897	8.564	89.749
CA604	B3	FNPC	14.392	8.428	85.822
CA604	B3	VDS	16.63	9.512	90.971
CA605	B1	CRA	16.888	10.672	87.858
CA605	B1	FNPC	16.705	10.369	82.69
CA605	B1	VDS	18.618	11.571	89.102
CA605	B2	CRA	16.572	10.498	89.051
CA605	B2	FNPC	16.6	10.01	84.573
CA605	B2	VDS	19.031	11.059	90.074
CA605	B3	CRA	17.598	10.708	86.183
CA605	B3	FNPC	16.116	9.914	84.073
CA605	B3	VDS	18.66	11.192	89.598
CR401bis	B1	CRA	14.55	8.383	88.074
CR401bis	B1	FNPC	14.561	8.113	82.034
CR401bis	B1	VDS	16.503	9.306	90.502
CR401bis	B2	CRA	15.611	8.906	89.819
CR401bis	B2	FNPC	14.746	7.743	77.839
CR401bis	B2	VDS	16.833	9.612	90.823
CR401bis	B3	CRA	15.326	8.744	88.461
CR401bis	B3	FNPC	13.404	7.864	83.349
CR401bis	B3	VDS	17.658	10.548	90.93
CR402bis	B1	CRA	14.81	8.115	87.304
CR402bis	B1	FNPC	14.653	8.095	85.648

CR402bis	B1	VDS	15.052	7.706	87.352
CR402bis	B2	CRA	14.677	8.061	89.066
CR402bis	B2	FNPC	14.938	8.137	83.917
CR402bis	B2	VDS	15.851	8.459	90.147
CR402bis	B3	CRA	14.621	8.312	89.95
CR402bis	B3	FNPC	14.757	8.135	84.931
CR402bis	B3	VDS	16.389	8.883	91.859
CR404	B1	CRA	14.319	8.146	89.264
CR404	B1	FNPC	14.595	8.545	85.8
CR404	B1	VDS	16.611	9.933	91.951
CR404	B2	CRA	14.221	7.631	87.928
CR404	B2	FNPC	14.609	8.545	85.8
CR404	B2	VDS	15.319	9.152	91.788
CR404	B3	CRA	14.222	8.078	90.077
CR404	B3	FNPC	14.563	8.545	85.8
CR404	B3	VDS	17.768	10.427	91.79
CR405bis	B1	CRA	11.815	7.014	89.089
CR405bis	B1	FNPC	12.035	7.137	84.989
CR405bis	B1	VDS	14.21	7.902	89.059
CR405bis	B2	CRA	12.798	7.838	89.712
CR405bis	B2	FNPC	12.049	7.137	84.989
CR405bis	B2	VDS	13.626	7.615	89.791
CR405bis	B3	CRA	12.237	7.432	89.087
CR405bis	B3	FNPC	12.003	7.137	84.989
CR405bis	B3	VDS	12.415	7.113	91.195
CR406	B1	CRA	14.086	8.077	88.746
CR406	B1	FNPC	14.003	8.134	86.676
CR406	B1	VDS	16.009	8.601	91.266
CR406	B2	CRA	13.91	7.803	89.927

CR406	B2	FNPC	13.462	7.78	86.859
CR406	B2	VDS	16.282	8.683	91.418
CR406	B3	CRA	13.88	7.638	90.223
CR406	B3	FNPC	13.855	7.772	84.506
CR406	B3	VDS	16.124	8.535	90.009
CR407	B1	CRA	13.395	7.423	89.324
CR407	B1	FNPC	14.148	7.889	87.079
CR407	B1	VDS	15.51	8.268	91.457
CR407	B2	CRA	13.627	7.506	88.684
CR407	B2	FNPC	13.573	7.735	83.833
CR407	B2	VDS	14.794	7.822	90.43
CR407	B3	CRA	13.458	8.04	89.648
CR407	B3	FNPC	13.267	7.424	87.737
CR407	B3	VDS	14.952	9.427	91.366
CR408bis	B1	CRA	12.348	7.316	88.643
CR408bis	B1	FNPC	12.782	7.653	84.476
CR408bis	B1	VDS	14.568	8.547	90.512
CR408bis	B2	CRA	12.49	7.613	88.688
CR408bis	B2	FNPC	12.462	7.097	85.439
CR408bis	B2	VDS	15.8	9.35	90.971
CR408bis	B3	CRA	12.445	7.52	85.02
CR408bis	B3	FNPC	12.583	7.394	85.106
CR408bis	B3	VDS	14.027	8.389	90.923
CR409	B1	CRA	13.938	8.065	89.663
CR409	B1	FNPC	13.734	8.324	87.87
CR409	B1	VDS	15.715	8.965	90.698
CR409	B2	CRA	14.289	8.484	90.757
CR409	B2	FNPC	13.442	7.378	87.041
CR409	B2	VDS	16.449	8.327	89.957

CR409	B3	CRA	14.389	8.007	90.46
CR409	B3	FNPC	13.091	6.423	86.143
CR409	B3	VDS	15.078	8.43	90.519
CR410	B1	CRA	14.932	7.865	87.16
CR410	B1	FNPC	14.426	8.338	83.326
CR410	B1	VDS	15.285	9.317	91.949
CR410	B2	CRA	14.183	7.98	89.551
CR410	B2	FNPC	14.044	7.978	84.123
CR410	B2	VDS	16.246	8.835	91.575
CR410	B3	CRA	14.979	8.491	87.223
CR410	B3	FNPC	14.271	8.661	85.086
CR410	B3	VDS	16.191	9.028	90.527
CR411bis	B1	CRA	14.198	7.686	88.868
CR411bis	B1	FNPC	14.616	8.458	84.06
CR411bis	B1	VDS	16.17	8.413	89.953
CR411bis	B2	CRA	14.403	7.774	88.716
CR411bis	B2	FNPC	14.63	8.458	84.06
CR411bis	B2	VDS	15.66	8.845	90.246
CR411bis	B3	CRA	14.43	8.194	89.539
CR411bis	B3	FNPC	14.584	8.492	84.332
CR411bis	B3	VDS	14.937	7.872	92.537
CR412	B1	CRA	12.191	7.253	88.112
CR412	B1	FNPC	13.06	8.266	86.549
CR412	B1	VDS	13.293	7.765	91.46
CR412	B2	CRA	13.195	7.849	88.564
CR412	B2	FNPC	12.204	7.717	86.062
CR412	B2	VDS	12.868	6.986	91.41
CR412	B3	CRA	12.39	7.519	89.597
CR412	B3	FNPC	12.136	7.684	87.23

CR412	B3	VDS	14.324	8.164	91.931
CR413bis	B1	CRA	13.995	7.975	89.556
CR413bis	B1	FNPC	14.886	8.64	83.247
CR413bis	B1	VDS	15.077	8.392	91.268
CR413bis	B2	CRA	14.008	8.151	90.541
CR413bis	B2	FNPC	14.9	8.647	83.287
CR413bis	B2	VDS	15.328	8.651	91.103
CR413bis	B3	CRA	14.245	8.559	89.858
CR413bis	B3	FNPC	14.854	8.64	83.247
CR413bis	B3	VDS	16.816	9.801	89.895
CR414	B1	CRA	15.089	8.427	84.378
CR414	B1	FNPC	13.778	8.185	83.943
CR414	B1	VDS	14.606	8.631	91.175
CR414	B2	CRA	13.7	8.92	88.414
CR414	B2	FNPC	14.994	8.49	84.956
CR414	B2	VDS	14.636	8.687	91.067
CR414	B3	CRA	13.618	8.325	89.066
CR414	B3	FNPC	12.774	7.726	85.539
CR414	B3	VDS	12.763	7.756	90.74
CR415	B1	CRA	14.356	9.106	88.387
CR415	B1	FNPC	14.787	8.899	82.933
CR415	B1	VDS	16.351	10.037	91.774
CR415	B2	CRA	14.37	9.106	88.387
CR415	B2	FNPC	14.716	10.021	83.802
CR415	B2	VDS	13.984	9.659	92.139
CR415	B3	CRA	14.324	9.106	88.387
CR415	B3	FNPC	13.814	8.815	85.51
CR415	B3	VDS	16.861	10.171	91.128
CR416	B1	CRA	13.322	8.141	87.602

CR416	B1	FNPC	13.658	8.25	82.411
CR416	B1	VDS	15.428	9.674	91.275
CR416	B2	CRA	13.856	7.997	88.502
CR416	B2	FNPC	13.775	7.921	82.359
CR416	B2	VDS	16.113	10.337	91.596
CR416	B3	CRA	12.995	8.113	90.399
CR416	B3	FNPC	13.805	7.735	83.042
CR416	B3	VDS	15.455	9.353	91.782
CR417bis	B1	CRA	13.795	7.702	88.301
CR417bis	B1	FNPC	14.223	8.617	87.312
CR417bis	B1	VDS	16.765	9.625	90.838
CR417bis	B2	CRA	14.452	8.212	88.069
CR417bis	B2	FNPC	13.977	7.965	84.257
CR417bis	B2	VDS	16.081	8.767	89.186
CR417bis	B3	CRA	14.207	8.184	89.797
CR417bis	B3	FNPC	14.061	8.31	85.933
CR417bis	B3	VDS	15.274	8.492	90.443
CR418	B1	CRA	13.905	8.423	87.6
CR418	B1	FNPC	14.263	8.33	85.016
CR418	B1	VDS	16.23	10.572	90.752
CR418	B2	CRA	15.141	8.827	88.623
CR418	B2	FNPC	13.994	8.65	86.682
CR418	B2	VDS	17.323	9.821	90.419
CR418	B3	CRA	14.656	8.995	89.108
CR418	B3	FNPC	14.933	7.111	81.023
CR418	B3	VDS	17.484	10.322	90.515
CR419	B1	CRA	13.492	9.05	85.247
CR419	B1	FNPC	13.724	8.554	85.473
CR419	B1	VDS	14.803	9.558	90.9

CR419	B2	CRA	13.782	8.984	88.892
CR419	B2	FNPC	13.912	8.377	84.487
CR419	B2	VDS	14.628	9.121	92.308
CR419	B3	CRA	13.929	9.517	88.947
CR419	B3	FNPC	14.041	8.191	83.432
CR419	B3	VDS	14.782	9.184	93.08
CR420	B1	CRA	12.355	8.377	89.593
CR420	B1	FNPC	14.051	9.539	85.051
CR420	B1	VDS	15.473	9.879	92.917
CR420	B2	CRA	13.545	8.969	89.297
CR420	B2	FNPC	14.834	9.717	81.766
CR420	B2	VDS	14.232	9.16	93.007
CR420	B3	CRA	13.621	8.675	90.333
CR420	B3	FNPC	13.85	8.498	86.507
CR420	B3	VDS	14.107	9.113	93.281
F201	B1	CRA	14.376	8.921	87.474
F201	B1	FNPC	15.084	9.256	83.053
F201	B1	VDS	16.47	10.995	91.495
F201	B2	CRA	14.704	8.828	86.931
F201	B2	FNPC	14.466	9.202	83.831
F201	B2	VDS	17.007	10.748	90.654
F201	B3	CRA	13.737	8.986	89.257
F201	B3	FNPC	14.607	9.577	87.646
F201	B3	VDS	14.904	9.692	92.414
F202	B1	CRA	14.28	8.764	89.156
F202	B1	FNPC	14.225	8.88	85.086
F202	B1	VDS	14.707	9.713	90.469
F202	B2	CRA	14.322	8.91	90.024
F202	B2	FNPC	14.298	9.256	84.986

F202	B2	VDS	15.028	9.924	91.886
F202	B3	CRA	14.869	9.368	88.755
F202	B3	FNPC	12.981	9.021	88.614
F202	B3	VDS	16.101	10.866	93.619
F203	B1	CRA	13.685	8.129	88.997
F203	B1	FNPC	15.107	10.173	86.237
F203	B1	VDS	17.152	10.401	90.122
F203	B2	CRA	14.423	8.536	90.041
F203	B2	FNPC	14.126	9.415	86.797
F203	B2	VDS	15.195	9.911	92.327
F203	B3	CRA	13.092	8.09	90.664
F203	B3	FNPC	13.085	8.649	87.288
F203	B3	VDS	15.899	10.515	92.455
F204	B1	CRA	14.291	9.17	89.382
F204	B1	FNPC	14.204	9.425	88.116
F204	B1	VDS	14.025	9.557	89.846
F204	B2	CRA	13.652	8.396	89.288
F204	B2	FNPC	14.682	9.929	85.895
F204	B2	VDS	17.274	10.486	90.871
F204	B3	CRA	14.667	9.072	90.361
F204	B3	FNPC	13.19	8.55	87.847
F204	B3	VDS	15.553	10.49	94.29
F205	B1	CRA	13.822	8.733	89.344
F205	B1	FNPC	13.892	9.095	86.573
F205	B1	VDS	14.766	9.656	90.304
F205	B2	CRA	14.215	9.283	87.824
F205	B2	FNPC	14.609	9.93	85.133
F205	B2	VDS	16.233	10.057	91.656
F205	B3	CRA	13.559	8.527	89.5

F205	B3	FNPC	13.068	9.089	87.051
F205	B3	VDS	14.949	9.881	92.837
F206	B1	CRA	14.628	8.43	89.066
F206	B1	FNPC	13.309	8.461	85.725
F206	B1	VDS	14.883	9.438	91.394
F206	B2	CRA	13.379	8.546	88.973
F206	B2	FNPC	13.596	8.332	85.52
F206	B2	VDS	16.758	10.275	92.038
F206	B3	CRA	14.656	8.762	91.062
F206	B3	FNPC	13.809	8.945	88.724
F206	B3	VDS	14.46	9.396	92.283
F207	B1	CRA	14.458	8.713	87.739
F207	B1	FNPC	13.898	9.246	85.571
F207	B1	VDS	17.122	10.748	90.657
F207	B2	CRA	14.762	9.29	90.258
F207	B2	FNPC	13.828	8.314	86.18
F207	B2	VDS	16.409	10.722	92.337
F207	B3	CRA	14.564	9.116	90.09
F207	B3	FNPC	14.211	8.782	83.207
F207	B3	VDS	15.231	10.141	93.146
F208	B1	CRA	13.321	8.024	88.575
F208	B1	FNPC	14.789	9.484	86.264
F208	B1	VDS	14.87	9.421	90.476
F208	B2	CRA	13.848	8.285	89.986
F208	B2	FNPC	13.571	8.404	86.275
F208	B2	VDS	15.682	9.983	91.898
F208	B3	CRA	14.174	8.391	89.521
F208	B3	FNPC	12.985	8.51	87.916
F208	B3	VDS	15.289	10.337	92.826

F209	B1	CRA	13.858	8.796	89.059
F209	B1	FNPC	14.133	8.697	85.799
F209	B1	VDS	15.746	9.608	90.498
F209	B2	CRA	13.872	8.796	89.059
F209	B2	FNPC	13.321	8.894	84.248
F209	B2	VDS	15.027	9.439	91.722
F209	B3	CRA	13.826	8.796	89.059
F209	B3	FNPC	13.79	9.129	87.417
F209	B3	VDS	15.505	9.98	91.631
F210	B1	CRA	13.748	8.327	87.543
F210	B1	FNPC	13.744	8.725	86.795
F210	B1	VDS	15.502	9.881	91.624
F210	B2	CRA	14.073	8.972	89.277
F210	B2	FNPC	13.713	8.197	81.082
F210	B2	VDS	13.518	7.263	89.868
F210	B3	CRA	13.435	7.908	88.76
F210	B3	FNPC	13.138	8.833	86.572
F210	B3	VDS	16.342	10.159	91.08
F211	B1	CRA	13.216	8.325	88.692
F211	B1	FNPC	14.062	8.989	86.464
F211	B1	VDS	15.685	10.546	91.389
F211	B2	CRA	14.017	8.471	88.779
F211	B2	FNPC	14.545	10.086	84.228
F211	B2	VDS	15.754	9.761	91.704
F211	B3	CRA	13.787	9.187	90.021
F211	B3	FNPC	14.806	10.117	82.67
F211	B3	VDS	15.596	10.152	91.118
F212	B1	CRA	12.825	8.688	89.129
F212	B1	FNPC	14.138	8.729	84.751

F212	B1	VDS	15.706	9.33	90.099
F212	B2	CRA	13.824	8.582	89.625
F212	B2	FNPC	12.794	8.91	88.289
F212	B2	VDS	16.234	9.274	89.167
F212	B3	CRA	13.965	8.835	90.419
F212	B3	FNPC	12.656	8.304	88.904
F212	B3	VDS	13.949	8.97	92.028
F213	B1	CRA	14.163	8.422	88.197
F213	B1	FNPC	14.18	9.011	87.109
F213	B1	VDS	13.824	8.809	90.981
F213	B2	CRA	14.117	8.814	88.651
F213	B2	FNPC	14.267	9.045	85.032
F213	B2	VDS	14.481	9.018	90.909
F213	B3	CRA	13.119	8.602	89.727
F213	B3	FNPC	13.294	8.911	88.859
F213	B3	VDS	14.024	9.442	90.373
F214	B1	CRA	13.798	8.342	88.866
F214	B1	FNPC	13.639	8.492	84.458
F214	B1	VDS	14.903	11.364	91.372
F214	B2	CRA	14.399	9.228	88.235
F214	B2	FNPC	13.672	8.961	86.769
F214	B2	VDS	16.869	10.775	92.49
F214	B3	CRA	14.126	8.927	90.669
F214	B3	FNPC	14.147	9.356	87.661
F214	B3	VDS	14.859	9.583	90.617
F215	B1	CRA	13.852	9.169	87.19
F215	B1	FNPC	14.844	9.75	83.461
F215	B1	VDS	15.754	10.034	90.189
F215	B2	CRA	14.923	9.11	89.582

F215	B2	FNPC	14.058	8.981	84.228
F215	B2	VDS	15.054	9.223	91.904
F215	B3	CRA	15.042	9.217	89.537
F215	B3	FNPC	13.957	9.477	88.082
F215	B3	VDS	15.745	10.579	91.229
F216	B1	CRA	14.491	8.615	88.449
F216	B1	FNPC	14.469	9.531	85.469
F216	B1	VDS	16.335	10.469	91.747
F216	B2	CRA	14.329	9.554	90.81
F216	B2	FNPC	14.136	9.184	86.506
F216	B2	VDS	16.793	10.709	91.98
F216	B3	CRA	14.963	9.116	88.034
F216	B3	FNPC	14.011	8.686	86.589
F216	B3	VDS	16.902	10.85	92.339
F217	B1	CRA	14.419	9.312	88.888
F217	B1	FNPC	14.45	9.255	87.408
F217	B1	VDS	15.922	10.2	90.346
F217	B2	CRA	13.853	8.34	90.236
F217	B2	FNPC	13.852	8.884	85.351
F217	B2	VDS	16.207	10.102	91.9
F217	B3	CRA	14.292	8.379	87.601
F217	B3	FNPC	13.372	8.569	86.887
F217	B3	VDS	14.983	9.39	90.809
F218	B1	CRA	14.323	9.109	89.841
F218	B1	FNPC	15.656	9.685	81.899
F218	B1	VDS	16.585	10.758	90.159
F218	B2	CRA	13.693	8.736	89.156
F218	B2	FNPC	13.049	8.249	88.09
F218	B2	VDS	16.749	10.658	92.236

F218	B3	CRA	14.07	8.959	90.983
F218	B3	FNPC	13.78	8.849	87.274
F218	B3	VDS	16.002	10.189	92.427
F219	B1	CRA	15.473	9.588	87.723
F219	B1	FNPC	14.32	8.707	85.615
F219	B1	VDS	16.005	9.945	91.095
F219	B2	CRA	15.036	9.201	88.901
F219	B2	FNPC	14.583	10.389	85.451
F219	B2	VDS	14.437	9.738	93.347
F219	B3	CRA	14.456	9.215	89.944
F219	B3	FNPC	14.031	9.726	86.583
F219	B3	VDS	15.43	9.909	92.279
F220	B1	CRA	14.548	8.599	89.656
F220	B1	FNPC	14.871	9.367	86.76
F220	B1	VDS	16.092	9.691	90.513
F220	B2	CRA	14.869	9.37	90.349
F220	B2	FNPC	14.296	9.119	86.475
F220	B2	VDS	15.963	9.802	91.691
F220	B3	CRA	15.03	9.081	90.043
F220	B3	FNPC	13.798	9.018	86.285
F220	B3	VDS	16.003	10.59	92.618
F221	B1	CRA	14.783	8.739	87.604
F221	B1	FNPC	15.546	9.197	82.272
F221	B1	VDS	16.542	10.009	90.238
F221	B2	CRA	15.168	9.199	88.783
F221	B2	FNPC	13.715	8.968	85.598
F221	B2	VDS	16.661	9.845	89.99
F221	B3	CRA	14.93	9.011	87.201
F221	B3	FNPC	14.811	9.993	87.59

F221	B3	VDS	15.835	9.979	91.936
F222	B1	CRA	14.094	8.7	89.109
F222	B1	FNPC	13.48	8.784	84.994
F222	B1	VDS	14.754	9.581	92.125
F222	B2	CRA	14.114	8.744	89.225
F222	B2	FNPC	13.38	9.46	87.699
F222	B2	VDS	15.686	9.741	92.048
F222	B3	CRA	13.969	9.314	90.046
F222	B3	FNPC	13.237	8.761	89.072
F222	B3	VDS	15.423	10.197	91.696
F223	B1	CRA	14.454	8.534	88.068
F223	B1	FNPC	14.7	9.202	86.163
F223	B1	VDS	16.333	10.301	90.804
F223	B2	CRA	14.941	9.329	87.871
F223	B2	FNPC	14.914	8.976	80.499
F223	B2	VDS	15.209	9.522	90.66
F223	B3	CRA	14.922	9.497	89.557
F223	B3	FNPC	14.837	9.305	84.611
F223	B3	VDS	16.61	10.541	90.959
F224	B1	CRA	12.939	8.068	88.823
F224	B1	FNPC	14.216	8.953	84.798
F224	B1	VDS	15.708	10.123	91.325
F224	B2	CRA	13.56	8.387	87.42
F224	B2	FNPC	13.003	8.828	87.052
F224	B2	VDS	15.564	9.448	91.551
F224	B3	CRA	13.255	8.376	89.169
F224	B3	FNPC	14.412	9.161	84.652
F224	B3	VDS	14.72	9.573	93.297
F225	B1	CRA	14.152	8.487	86.776

F225	B1	FNPC	14.681	9.224	87.765
F225	B1	VDS	16.376	9.858	91.088
F225	B2	CRA	15.319	8.869	87.554
F225	B2	FNPC	14.167	8.801	81.572
F225	B2	VDS	16.26	10.5	92.762
F225	B3	CRA	13.516	8.461	89.94
F225	B3	FNPC	14.015	8.249	87.11
F225	B3	VDS	15.869	10.108	93.551
F226	B1	CRA	14.082	8.97	88.301
F226	B1	FNPC	13.988	8.701	84.711
F226	B1	VDS	15.881	11.184	89.112
F226	B2	CRA	14.096	8.97	88.301
F226	B2	FNPC	13.6	8.43	82.553
F226	B2	VDS	16.411	9.946	91.534
F226	B3	CRA	14.05	8.97	88.301
F226	B3	FNPC	14.182	8.627	85.083
F226	B3	VDS	14.804	9.901	93.774
F227	B1	CRA	13.832	8.414	89.326
F227	B1	FNPC	13.86	8.401	86.115
F227	B1	VDS	13.962	8.398	89.88
F227	B2	CRA	13.11	7.92	89.287
F227	B2	FNPC	13.782	8.334	85.518
F227	B2	VDS	15.353	9.1	89.745
F227	B3	CRA	13.704	8.667	90.408
F227	B3	FNPC	13.058	8.242	86.472
F227	B3	VDS	14.666	9.762	93.175
F228	B1	CRA	13.208	8.892	89.457
F228	B1	FNPC	12.944	8.49	88.465
F228	B1	VDS	15.8	10.806	91.175

F228	B2	CRA	13.348	8.477	89.279
F228	B2	FNPC	13.852	9.074	85.479
F228	B2	VDS	16.983	10.738	91.54
F228	B3	CRA	13.681	9.83	88.146
F228	B3	FNPC	14.516	9.954	87.45
F228	B3	VDS	13.961	9.557	92.762
F229	B1	CRA	12.889	8.133	86.468
F229	B1	FNPC	14.193	9.873	87.428
F229	B1	VDS	14.535	9.104	90.95
F229	B2	CRA	13.993	8.935	89.458
F229	B2	FNPC	13.726	9.106	87.591
F229	B2	VDS	14.229	8.765	92.157
F229	B3	CRA	13.448	8.858	89.969
F229	B3	FNPC	13.501	8.983	88.973
F229	B3	VDS	13.998	9.656	91.901
F230	B1	CRA	12.03	8.546	89.452
F230	B1	FNPC	14.178	9.405	88.326
F230	B1	VDS	14.861	9.52	91.971
F230	B2	CRA	13.519	8.822	89.167
F230	B2	FNPC	13.505	9.142	89.417
F230	B2	VDS	14.775	9.471	91.823
F230	B3	CRA	13.871	9.116	90.294
F230	B3	FNPC	13.435	9.133	87.889
F230	B3	VDS	13.955	9.289	90.5
F231	B1	CRA	13.631	8.8	89.62
F231	B1	FNPC	12.854	8.879	88.139
F231	B1	VDS	14.601	9.232	90.756
F231	B2	CRA	12.357	8.673	90.326
F231	B2	FNPC	12.551	9.003	87.458

F231	B2	VDS	14.232	9.211	91.485
F231	B3	CRA	13.614	8.546	86.525
F231	B3	FNPC	12.266	9.034	90.208
F231	B3	VDS	14.349	9.087	92.55
F232	B1	CRA	12.811	8.366	90.264
F232	B1	FNPC	13.481	8.356	82.642
F232	B1	VDS	14.144	9.563	91.724
F232	B2	CRA	12.961	8.675	90.597
F232	B2	FNPC	12.961	9.05	87.528
F232	B2	VDS	14.389	9.276	92.094
F232	B3	CRA	12.964	7.968	89.242
F232	B3	FNPC	12.934	8.711	88.752
F232	B3	VDS	14.142	9.095	91.315
F233	B1	CRA	13.271	8.798	87.399
F233	B1	FNPC	14.952	10.801	87.416
F233	B1	VDS	15.603	9.971	91.4
F233	B2	CRA	12.435	9.063	87.075
F233	B2	FNPC	13.035	9.652	87.911
F233	B2	VDS	15.095	9.702	91.627
F233	B3	CRA	13.503	9.418	89.84
F233	B3	FNPC	13.064	8.807	88.533
F233	B3	VDS	15.491	9.851	91.854
F234	B1	CRA	13.198	8.769	89.898
F234	B1	FNPC	13.152	8.955	87.452
F234	B1	VDS	14.488	9.082	90.679
F234	B2	CRA	13.212	8.769	89.898
F234	B2	FNPC	12.916	8.664	88.688
F234	B2	VDS	14.17	9.218	91.819
F234	B3	CRA	13.166	8.769	89.898

F234	B3	FNPC	14.226	9.819	84.863
F234	B3	VDS	14.613	9.846	92.853
F235	B1	CRA	13.493	8.724	89.791
F235	B1	FNPC	14.343	10.422	86.282
F235	B1	VDS	15.022	9.578	91.941
F235	B2	CRA	13.858	9.122	90.91
F235	B2	FNPC	13.299	9.182	88.296
F235	B2	VDS	14.027	8.867	91.898
F235	B3	CRA	13.486	9.035	91.01
F235	B3	FNPC	14.522	9.126	88.028
F235	B3	VDS	14.831	9.692	93.57
F236	B1	CRA	12.989	8.471	89.352
F236	B1	FNPC	12.734	8.489	87.466
F236	B1	VDS	14.47	9.282	91.674
F236	B2	CRA	13.097	8.547	90.08
F236	B2	FNPC	14.024	9.84	87.485
F236	B2	VDS	15.358	9.713	92.335
F236	B3	CRA	13.236	8.747	90.602
F236	B3	FNPC	12.819	8.98	87.74
F236	B3	VDS	14.139	9.086	92.873
F237	B1	CRA	14.228	9.073	88.789
F237	B1	FNPC	13.322	9.151	87.969
F237	B1	VDS	14.482	8.922	91.036
F237	B2	CRA	14.04	9.525	89.941
F237	B2	FNPC	13.447	9.453	87.178
F237	B2	VDS	15.786	10.046	91.804
F237	B3	CRA	13.348	8.716	91.03
F237	B3	FNPC	13.795	9.444	88.097
F237	B3	VDS	14.907	9.511	92.973

F238	B1	CRA	13.172	8.681	88.819
F238	B1	FNPC	13.043	9.208	86.075
F238	B1	VDS	14.432	9.481	91.992
F238	B2	CRA	13.567	8.937	89.912
F238	B2	FNPC	14.054	10.056	86.962
F238	B2	VDS	14.984	9.418	91.558
F238	B3	CRA	13.138	8.616	88.844
F238	B3	FNPC	13.379	9.248	88.496
F238	B3	VDS	13.881	8.56	92.365
F239	B1	CRA	13.559	8.531	89.541
F239	B1	FNPC	13.356	8.873	87.84
F239	B1	VDS	16.309	10.668	91.207
F239	B2	CRA	13.852	8.353	89.955
F239	B2	FNPC	12.619	8.62	88.543
F239	B2	VDS	15.259	9.956	91.379
F239	B3	CRA	14.122	9.22	90.235
F239	B3	FNPC	12.735	8.879	87.88
F239	B3	VDS	15.959	10.153	91.074
F240	B1	CRA	13.775	8.652	89.985
F240	B1	FNPC	13.751	8.827	87.389
F240	B1	VDS	16.948	10.514	91.631
F240	B2	CRA	13.647	8.671	88.974
F240	B2	FNPC	13.761	8.719	86.921
F240	B2	VDS	16.398	10.341	91.123
F240	B3	CRA	14.251	8.771	89.017
F240	B3	FNPC	13.938	8.179	82.027
F240	B3	VDS	15.89	10.396	92.853
F241	B1	CRA	13.543	8.416	89.264
F241	B1	FNPC	14.295	10.075	86.943

F241	B1	VDS	15.868	10.214	92.264
F241	B2	CRA	14.534	9.101	90.309
F241	B2	FNPC	13.401	9.374	87.635
F241	B2	VDS	14.485	9.421	91.922
F241	B3	CRA	13.787	9.163	90.291
F241	B3	FNPC	14.524	9.645	85.84
F241	B3	VDS	15.102	9.984	90.882
F242	B1	CRA	13.886	8.658	89.726
F242	B1	FNPC	14.357	9.21	85.587
F242	B1	VDS	15.655	9.169	90.487
F242	B2	CRA	14.186	8.79	89.468
F242	B2	FNPC	13.736	8.942	85.569
F242	B2	VDS	15.672	9.69	91.943
F242	B3	CRA	14.295	8.991	90.285
F242	B3	FNPC	13.703	9.269	86.352
F242	B3	VDS	16.064	10.43	91.809
F243	B1	CRA	14.868	8.743	87.606
F243	B1	FNPC	14.176	8.844	85.607
F243	B1	VDS	15.986	9.82	89.799
F243	B2	CRA	14.184	8.69	88.004
F243	B2	FNPC	14.021	8.845	84.358
F243	B2	VDS	16.208	10.127	90.235
F243	B3	CRA	15	9.577	88.771
F243	B3	FNPC	15.02	9.765	82.731
F243	B3	VDS	16.541	9.732	90.019
F244	B1	CRA	14.668	8.665	87.202
F244	B1	FNPC	14.65	9.951	86.78
F244	B1	VDS	17.221	9.471	88.661
F244	B2	CRA	13.968	8.331	88.87

F244	B2	FNPC	14.643	9.194	84.882
F244	B2	VDS	17.002	10.339	89.774
F244	B3	CRA	15.079	9.772	90.337
F244	B3	FNPC	13.636	9.118	86.513
F244	B3	VDS	16.199	9.874	89.29
F245	B1	CRA	13.605	9.151	87.923
F245	B1	FNPC	14.643	11.525	85.5
F245	B1	VDS	13.764	8.848	91.868
F245	B2	CRA	13.619	9.151	87.923
F245	B2	FNPC	14.476	8.986	81.658
F245	B2	VDS	14.619	9.194	91.028
F245	B3	CRA	13.573	9.151	87.923
F245	B3	FNPC	14.521	10.274	83.727
F245	B3	VDS	13.98	9.009	90.422
F246	B1	CRA	11.854	8.141	86.267
F246	B1	FNPC	15.333	9.49	91.074
F246	B1	VDS	13.515	8.612	87.5
F246	B2	CRA	14.561	9.438	91.292
F246	B2	FNPC	13.302	8.635	89.259
F246	B2	VDS	14.216	9.454	92.288
F246	B3	CRA	13.169	8.808	88.928
F246	B3	FNPC	14.279	9.08	90.315
F246	B3	VDS	13.826	9.052	90.042
F248	B1	CRA	12.678	8.61	89.872
F248	B1	FNPC	13.508	7.97	90.928
F248	B1	VDS	13.158	8.129	91.315
F248	B2	CRA	12.692	8.61	89.872
F248	B2	FNPC	13.522	7.97	90.928
F248	B2	VDS	13.172	8.129	91.315

F248	B3	CRA	12.636	8.644	90.174
F248	B3	FNPC	13.47	8.001	91.236
F248	B3	VDS	13.119	8.16	91.625
F250	B1	CRA	13.922	8.621	88.913
F250	B1	FNPC	13.635	9.059	87.708
F250	B1	VDS	15.522	9.971	90.66
F250	B2	CRA	13.323	8.345	89.224
F250	B2	FNPC	13.655	9.104	88.077
F250	B2	VDS	13.287	8.517	90.77
F250	B3	CRA	13.968	8.638	89.363
F250	B3	FNPC	13.609	9.104	88.077
F250	B3	VDS	15.014	9.594	90.589
F251	B1	CRA	13.994	8.414	88.895
F251	B1	FNPC	14.416	8.901	84.518
F251	B1	VDS	15.845	9.423	91.034
F251	B2	CRA	12.916	7.796	89.42
F251	B2	FNPC	13.58	8.335	84.731
F251	B2	VDS	15.573	9.932	92.956
F251	B3	CRA	13.612	8.288	89.73
F251	B3	FNPC	13.315	8.053	84.397
F251	B3	VDS	16.006	9.947	89.289
F252	B1	CRA	13.708	8.663	89.694
F252	B1	FNPC	14.814	8.871	84.578
F252	B1	VDS	17.718	9.763	90.304
F252	B2	CRA	14.065	8.408	89.677
F252	B2	FNPC	13.612	8.777	85.364
F252	B2	VDS	17.155	9.625	92.684
F252	B3	CRA	14.841	8.755	88.565
F252	B3	FNPC	14.59	8.398	82.39

F252	B3	VDS	17.739	9.747	91.122
F253	B1	CRA	13.324	8.323	90.713
F253	B1	FNPC	15.018	8.647	82.795
F253	B1	VDS	15.974	9.503	91.556
F253	B2	CRA	13.223	8.916	89.546
F253	B2	FNPC	15.164	9.097	83.366
F253	B2	VDS	16.916	9.933	90.479
F253	B3	CRA	13.873	8.376	89.537
F253	B3	FNPC	14.974	8.127	83.963
F253	B3	VDS	16.37	10.257	92.238
F254	B1	CRA	13.596	8.112	87.554
F254	B1	FNPC	13.384	8.463	87.052
F254	B1	VDS	15.028	8.892	90.325
F254	B2	CRA	13.636	8.381	89.441
F254	B2	FNPC	14	8.525	82.331
F254	B2	VDS	14.792	8.712	91.186
F254	B3	CRA	14.226	8.923	89.915
F254	B3	FNPC	14.654	8.177	82.685
F254	B3	VDS	15.423	8.7	91.61
F255	B1	CRA	13.542	8.148	89.793
F255	B1	FNPC	13.885	8.261	87.436
F255	B1	VDS	15.056	7.844	90.174
F255	B2	CRA	13.523	8.765	89.75
F255	B2	FNPC	13.757	8.397	87.248
F255	B2	VDS	15.453	9.641	89.831
F255	B3	CRA	14.209	8.675	89.696
F255	B3	FNPC	14	8.213	83.847
F255	B3	VDS	15.447	8.336	89.581
F256	B1	CRA	13.209	8.915	89.74

F256	B1	FNPC	13.664	9.35	86.402
F256	B1	VDS	14.488	9.571	91.415
F256	B2	CRA	13.223	8.915	89.74
F256	B2	FNPC	12.825	8.1	86.878
F256	B2	VDS	14.68	10.008	91.98
F256	B3	CRA	13.177	8.915	89.74
F256	B3	FNPC	13.206	8.744	86.788
F256	B3	VDS	14.764	10.646	91.64
I901	B1	CRA	13.437	8.563	89.031
I901	B1	FNPC	13.083	8.45	87.709
I901	B1	VDS	13.198	8.12	91.45
I901	B2	CRA	13.435	8.21	90.223
I901	B2	FNPC	13.584	9.312	87.37
I901	B2	VDS	14.234	9.029	92.638
I901	B3	CRA	12.691	8.011	90.842
I901	B3	FNPC	13.538	9.067	84.942
I901	B3	VDS	13.778	9.023	93.712
I902	B1	CRA	11.562	7.49	88.227
I902	B1	FNPC	12.178	7.786	88.297
I902	B1	VDS	11.6	7.408	92.777
I902	B2	CRA	11.277	7.463	90.902
I902	B2	FNPC	12.205	7.838	88.663
I902	B2	VDS	12.221	7.754	92.352
I902	B3	CRA	11.418	7.619	90.881
I902	B3	FNPC	12.159	7.838	88.663
I902	B3	VDS	13.298	8.626	91.395
I903	B1	CRA	13.175	8.083	89.108
I903	B1	FNPC	14.066	8.876	84.003
I903	B1	VDS	14.607	9.648	92.735

I903	B2	CRA	12.872	8.174	88.41
I903	B2	FNPC	13.041	8.626	85.844
I903	B2	VDS	14.91	9.697	91.939
I903	B3	CRA	13.207	8.895	90.688
I903	B3	FNPC	12.713	8.224	87.058
I903	B3	VDS	14.622	9.308	91.6
L501	B1	CRA	16.807	10.684	88.713
L501	B1	FNPC	15.309	9.676	87.886
L501	B1	VDS	21.003	12.968	92.441
L501	B2	CRA	17.026	12.482	90.882
L501	B2	FNPC	15.798	10.452	86.917
L501	B2	VDS	16.597	10.76	94.257
L501	B3	CRA	15.842	9.994	90.285
L501	B3	FNPC	15.896	9.854	89.747
L501	B3	VDS	18.081	11.156	93.098
U801	B1	CRA	17.98	12.191	88.188
U801	B1	FNPC	17.368	10.924	89.544
U801	B1	VDS	18.165	11.77	92.84
U801	B2	CRA	18.523	15.697	90.244
U801	B2	FNPC	18.448	13.904	90.989
U801	B2	VDS	18.692	13.015	92.928
U801	B3	CRA	17.863	13.6	90.959
U801	B3	FNPC	17.789	12.353	91.569
U801	B3	VDS	18.777	11.841	93.031
V301	B1	CRA	12.378	7.908	88.643
V301	B1	FNPC	12.747	7.465	87.851
V301	B1	VDS	15.508	9.492	91.727
V301	B2	CRA	13.036	8.242	89.66
V301	B2	FNPC	12.701	8.126	85.066

V301	B2	VDS	14.41	8.261	91.281
V301	B3	CRA	12.936	8.294	89.378
V301	B3	FNPC	12.769	7.418	85.702
V301	B3	VDS	15.291	9.671	90.918
V302	B1	CRA	13.114	8.531	89.574
V302	B1	FNPC	13.135	8.21	85.885
V302	B1	VDS	14.24	8.554	92.658
V302	B2	CRA	12.987	7.824	90.575
V302	B2	FNPC	12.67	8.047	86.303
V302	B2	VDS	14.523	8.28	92.371
V302	B3	CRA	13.186	7.576	89.757
V302	B3	FNPC	12.864	8.147	86.242
V302	B3	VDS	14.861	9.476	92.399
V303	B1	CRA	14.008	8.143	86.592
V303	B1	FNPC	13.179	8.067	83.456
V303	B1	VDS	15.279	9.659	92.135
V303	B2	CRA	13.836	8.661	86.424
V303	B2	FNPC	12.778	8.242	82.743
V303	B2	VDS	15.085	8.991	92.434
V303	B3	CRA	13.388	8.679	89.421
V303	B3	FNPC	12.94	8.173	83.248
V303	B3	VDS	14.513	8.805	93.43
V304	B1	CRA	13.326	8.725	89.611
V304	B1	FNPC	13.136	8.908	86.243
V304	B1	VDS	12.948	8.709	92.635
V304	B2	CRA	12.889	8.288	90.439
V304	B2	FNPC	13.049	8.454	83.753
V304	B2	VDS	14.006	9.2	93.047
V304	B3	CRA	13.207	9.086	89.838

V304	B3	FNPC	16.372	14.288	80.834
V304	B3	VDS	14.492	9.328	93.367
WU101	B1	CRA	14.046	8.677	88.091
WU101	B1	FNPC	14.145	8.846	85.663
WU101	B1	VDS	15.745	10.136	93.262
WU101	B2	CRA	14.88	9.245	89.85
WU101	B2	FNPC	13.435	8.395	84.49
WU101	B2	VDS	16.127	10.444	92.758
WU101	B3	CRA	14.821	9.397	88.746
WU101	B3	FNPC	14	9.253	85.38
WU101	B3	VDS	16.342	10.627	91.323
WU102	B1	CRA	15.381	8.487	89.484
WU102	B1	FNPC	15.427	8.7	84.118
WU102	B1	VDS	16.977	9.542	92.259
WU102	B2	CRA	15.553	8.534	88.79
WU102	B2	FNPC	15.197	9.057	86.167
WU102	B2	VDS	17.329	9.538	91.784
WU102	B3	CRA	15.137	8.621	87.799
WU102	B3	FNPC	15.181	8.512	87.053
WU102	B3	VDS	17.288	10.352	91.79
WU103	B1	CRA	14.603	8.673	89.26
WU103	B1	FNPC	13.586	9.062	85.819
WU103	B1	VDS	16.124	9.47	91.12
WU103	B2	CRA	14.762	8.515	88.794
WU103	B2	FNPC	13.763	7.979	83.022
WU103	B2	VDS	16.1	9.563	92.001
WU103	B3	CRA	14.884	8.651	89.375
WU103	B3	FNPC	13.703	7.791	85.015
WU103	B3	VDS	16.334	10.156	90.204

WU104	B1	CRA	12.902	8.009	89.873
WU104	B1	FNPC	13.675	8.518	86.347
WU104	B1	VDS	14.396	8.27	89.332
WU104	B2	CRA	13.047	7.543	89.817
WU104	B2	FNPC	13.572	8.152	85.45
WU104	B2	VDS	15.091	9.139	91.752
WU104	B3	CRA	12.744	7.843	91.251
WU104	B3	FNPC	13.538	8.121	82.937
WU104	B3	VDS	14.743	8.334	89.589
WU105	B1	CRA	15.266	8.457	86.35
WU105	B1	FNPC	15.101	8.799	81.824
WU105	B1	VDS	15.784	9.831	91.92
WU105	B2	CRA	15.431	9.956	90.784
WU105	B2	FNPC	14.562	9.419	82.788
WU105	B2	VDS	14.647	9.47	93.001
WU105	B3	CRA	14.034	8.199	85.227
WU105	B3	FNPC	14.621	8.569	82.877
WU105	B3	VDS	13.38	7.942	90.425
WU106	B1	CRA	13.818	8.485	87.626
WU106	B1	FNPC	13.454	8.647	84.039
WU106	B1	VDS	14.989	9.713	91.634
WU106	B2	CRA	13.791	8.056	87.429
WU106	B2	FNPC	14.324	9.991	87.04
WU106	B2	VDS	15.378	9.73	92.415
WU106	B3	CRA	13.661	8.147	88.789
WU106	B3	FNPC	14.215	7.942	84.182
WU106	B3	VDS	17.042	11.617	91.598
WU107	B1	CRA	16.956	10.391	86.668
WU107	B1	FNPC	16.101	10.121	81.557

WU107	B1	VDS	19.349	11.67	91.592
WU107	B2	CRA	16.97	10.391	86.668
WU107	B2	FNPC	15.35	8.713	81.077
WU107	B2	VDS	18.878	11.833	92.063
WU107	B3	CRA	16.924	10.391	86.668
WU107	B3	FNPC	16.638	10.005	80.638
WU107	B3	VDS	19.796	12.97	90.043
WU108	B1	CRA	13.967	8.012	87.159
WU108	B1	FNPC	14.729	9.575	84.707
WU108	B1	VDS	16.021	8.681	90.148
WU108	B2	CRA	13.444	7.674	88.603
WU108	B2	FNPC	14.412	8.197	84.066
WU108	B2	VDS	16.617	9.145	90.77
WU108	B3	CRA	13.841	8.28	90.267
WU108	B3	FNPC	14.083	7.561	84.712
WU108	B3	VDS	15.877	9.162	91.142
WU109	B1	CRA	13.354	8.423	86.962
WU109	B1	FNPC	13.503	8.832	85.37
WU109	B1	VDS	13.841	8.793	92.572
WU109	B2	CRA	13.683	8.733	90.637
WU109	B2	FNPC	13.271	9.255	87.556
WU109	B2	VDS	15.847	10.132	93.05
WU109	B3	CRA	13.478	8.902	89.995
WU109	B3	FNPC	14.436	8.656	86.031
WU109	B3	VDS	14.591	10.198	93.581
WU110	B1	CRA	14.843	8.777	87.023
WU110	B1	FNPC	15.485	8.899	81.282
WU110	B1	VDS	16.801	10.253	92.376
WU110	B2	CRA	15.027	9.178	88.945

WU110	B2	FNPC	15.267	8.81	82.865
WU110	B2	VDS	17.068	9.775	91.447
WU110	B3	CRA	15.481	8.493	84.082
WU110	B3	FNPC	14.895	8.437	82.815
WU110	B3	VDS	15.033	8.626	90.196
WU111	B1	CRA	10.534	6.944	90.45
WU111	B1	FNPC	13.457	10.437	87.205
WU111	B1	VDS	12.788	7.547	91.667
WU111	B2	CRA	10.246	6.886	90.435
WU111	B2	FNPC	11.602	7.869	86.509
WU111	B2	VDS	13.206	7.944	91.778
WU111	B3	CRA	11.363	7.918	89.229
WU111	B3	FNPC	10.745	7.754	87.731
WU111	B3	VDS	14.752	8.967	91.469
WU112	B1	CRA	14.655	8.347	88.35
WU112	B1	FNPC	12.915	8.32	87.522
WU112	B1	VDS	15.481	9.466	90.474
WU112	B2	CRA	13.577	8.203	89.602
WU112	B2	FNPC	13.983	8.74	84.663
WU112	B2	VDS	15.451	9.113	92.01
WU112	B3	CRA	14.077	8.294	89.124
WU112	B3	FNPC	13.412	7.581	83.733
WU112	B3	VDS	14.325	8.854	92.631
WU113	B1	CRA	12.285	7.374	90.356
WU113	B1	FNPC	11.973	6.878	88.963
WU113	B1	VDS	12.76	7.186	90.222
WU113	B2	CRA	12.622	7.882	90.321
WU113	B2	FNPC	12.971	8.303	85.979
WU113	B2	VDS	13.688	7.402	90.487

WU113	B3	CRA	13.025	7.981	90.201
WU113	B3	FNPC	12.587	7.418	88.802
WU113	B3	VDS	12.956	7.857	90.426
WU114	B1	CRA	13.977	8.477	89.024
WU114	B1	FNPC	14.197	8.616	87.151
WU114	B1	VDS	17.144	9.968	92.092
WU114	B2	CRA	14.567	8.471	89.671
WU114	B2	FNPC	14.294	9.374	87.482
WU114	B2	VDS	16.546	9.269	91.19
WU114	B3	CRA	15.488	8.812	89.16
WU114	B3	FNPC	14.693	10.076	85.187
WU114	B3	VDS	15.462	9.476	91.427
WU115	B1	CRA	16.186	8.753	81.899
WU115	B1	FNPC	15.768	8.745	86.681
WU115	B1	VDS	16.653	11.348	94.042
WU115	B2	CRA	15.92	9.358	84.735
WU115	B2	FNPC	15.762	9.324	86.076
WU115	B2	VDS	20.769	13.54	92.866
WU115	B3	CRA	15.547	10.196	90.677
WU115	B3	FNPC	16.742	11.85	83.5
WU115	B3	VDS	18.703	11.378	91.709
WU116	B1	CRA	15.605	9.338	87.761
WU116	B1	FNPC	15.007	8.169	82.858
WU116	B1	VDS	16.596	9.406	90.808
WU116	B2	CRA	15.424	9.394	88.114
WU116	B2	FNPC	14.66	8.387	85.481
WU116	B2	VDS	16.607	9.038	90.19
WU116	B3	CRA	15.171	8.779	89.475
WU116	B3	FNPC	14.604	7.822	87.779

WU116	B3	VDS	16.958	9.092	91.074
WU117	B1	CRA	15.233	7.921	87.93
WU117	B1	FNPC	15.35	8.632	80.599
WU117	B1	VDS	17.015	9.546	92.474
WU117	B2	CRA	15.21	8.005	88.453
WU117	B2	FNPC	15.198	8.515	81.785
WU117	B2	VDS	16.644	9.487	92.046
WU117	B3	CRA	15.357	8.273	89.712
WU117	B3	FNPC	14.447	7.993	82.925
WU117	B3	VDS	17.366	9.703	92.881
WU118	B1	CRA	16.064	8.942	86.815
WU118	B1	FNPC	16.302	8.949	84.751
WU118	B1	VDS	16.872	9.651	91.449
WU118	B2	CRA	16.606	9.578	90.739
WU118	B2	FNPC	15.91	9.07	82.934
WU118	B2	VDS	18.395	10.859	91.34
WU118	B3	CRA	15.963	9.721	88.62
WU118	B3	FNPC	15.294	8.719	83.773
WU118	B3	VDS	18.091	10.315	91.678
WU119	B1	CRA	13.161	8.196	90.657
WU119	B1	FNPC	13.724	9.076	86.919
WU119	B1	VDS	14.601	9.383	92.438
WU119	B2	CRA	13.75	8.563	89.712
WU119	B2	FNPC	13.738	9.076	86.919
WU119	B2	VDS	16.917	11.537	93.325
WU119	B3	CRA	13.464	8.376	89.617
WU119	B3	FNPC	13.692	9.076	86.919
WU119	B3	VDS	15.34	10.498	93.761
WU120	B1	CRA	15.724	9.173	89.42

WU120	B1	FNPC	15.241	8.963	85.893
WU120	B1	VDS	15.514	9.259	91.223
WU120	B2	CRA	15.66	8.693	89.452
WU120	B2	FNPC	15.255	8.963	85.893
WU120	B2	VDS	16.176	9.404	92.053
WU120	B3	CRA	15.824	9.349	89.904
WU120	B3	FNPC	15.209	8.963	85.893
WU120	B3	VDS	17.439	9.995	91.303
WU121	B1	CRA	15.259	8.438	86.928
WU121	B1	FNPC	16.112	9.621	83.19
WU121	B1	VDS	16.649	10.691	92.076
WU121	B2	CRA	15.497	8.553	88.631
WU121	B2	FNPC	15.69	9.332	85.7
WU121	B2	VDS	16.28	9.934	91.568
WU121	B3	CRA	16.675	9.47	89.695
WU121	B3	FNPC	15.322	9.187	86.123
WU121	B3	VDS	16.16	10.27	92.782
WU122	B1	CRA	17.895	12.748	87.342
WU122	B1	FNPC	16.912	11.322	86.67
WU122	B1	VDS	18.625	11.987	93.112
WU122	B2	CRA	18.218	13.578	89.714
WU122	B2	FNPC	16.937	11.342	86.727
WU122	B2	VDS	18.053	11.366	93.949
WU122	B3	CRA	16.348	11.45	91.178
WU122	B3	FNPC	16.88	11.322	86.67
WU122	B3	VDS	18.51	10.957	92.709
WU123	B1	CRA	15.678	8.962	89.497
WU123	B1	FNPC	15.27	10.509	91.898
WU123	B1	VDS	17.361	10.827	91.718

WU123	B2	CRA	15.98	10.062	89.918
WU123	B2	FNPC	15.357	10.501	84.292
WU123	B2	VDS	17.676	10.977	92.011
WU123	B3	CRA	15.779	9.913	90.27
WU123	B3	FNPC	15.275	10.524	88.243
WU123	B3	VDS	16.996	10.474	93.314
WU124	B1	CRA	15.505	8.026	84.774
WU124	B1	FNPC	15.592	8.819	84.145
WU124	B1	VDS	17.833	10.027	91.188
WU124	B2	CRA	14.208	8.445	88.812
WU124	B2	FNPC	15.606	8.819	84.145
WU124	B2	VDS	17.04	9.648	91.413
WU124	B3	CRA	15.56	8.603	86.98
WU124	B3	FNPC	15.56	8.819	84.145
WU124	B3	VDS	18.298	10.26	89.698
WU125	B1	CRA	14.576	8.181	86.943
WU125	B1	FNPC	14.689	7.8	84.087
WU125	B1	VDS	16.278	9.193	90.634
WU125	B2	CRA	14.991	9.042	88.898
WU125	B2	FNPC	14.36	8.215	85.478
WU125	B2	VDS	17.574	9.933	92.435
WU125	B3	CRA	15.457	9.45	89.808
WU125	B3	FNPC	15.481	8.75	81.472
WU125	B3	VDS	17.074	10.552	91.187
WU126	B1	CRA	11.791	7.064	88.901
WU126	B1	FNPC	11.986	7.117	85.127
WU126	B1	VDS	13.658	7.59	89.727
WU126	B2	CRA	11.748	7.188	89.429
WU126	B2	FNPC	12	7.117	85.127

WU126	B2	VDS	13.518	7.212	89.529
WU126	B3	CRA	12.786	7.887	90.491
WU126	B3	FNPC	11.954	7.117	85.127
WU126	B3	VDS	13.302	7.853	90.684
WU127	B1	CRA	13.791	7.996	87.078
WU127	B1	FNPC	13.335	8.611	84.838
WU127	B1	VDS	14.516	9.801	89.903
WU127	B2	CRA	13.613	9.204	89.824
WU127	B2	FNPC	13.349	8.611	84.838
WU127	B2	VDS	14.932	9.607	91.552
WU127	B3	CRA	13.882	8.217	88.274
WU127	B3	FNPC	13.303	8.611	84.838
WU127	B3	VDS	14.165	8.933	90.395
WU128	B1	CRA	16.62	9.973	89.273
WU128	B1	FNPC	16.558	9.431	81.918
WU128	B1	VDS	17.672	9.283	91.639
WU128	B2	CRA	16.634	9.973	89.273
WU128	B2	FNPC	15.996	11.003	90.989
WU128	B2	VDS	19.479	11.667	92.223
WU128	B3	CRA	16.588	9.973	89.273
WU128	B3	FNPC	15.983	10.065	83.605
WU128	B3	VDS	18.409	11.355	92.228
WU129	B1	CRA	13.129	8.086	88.942
WU129	B1	FNPC	13.433	8.369	84.932
WU129	B1	VDS	14.848	9.599	90.52
WU129	B2	CRA	13.762	8.84	89.542
WU129	B2	FNPC	13.447	8.369	84.932
WU129	B2	VDS	14.816	8.785	90.964
WU129	B3	CRA	13.744	7.742	87.181

WU129	B3	FNPC	13.401	8.369	84.932
WU129	B3	VDS	15.191	9.258	90.442
WU130	B1	CRA	16.783	9.611	88.432
WU130	B1	FNPC	16.01	8.247	79.001
WU130	B1	VDS	17.629	10.094	91.589
WU130	B2	CRA	16.539	8.846	88.006
WU130	B2	FNPC	14.992	8.508	82.794
WU130	B2	VDS	17.681	9.663	91.064
WU130	B3	CRA	16.571	9.88	89.62
WU130	B3	FNPC	15.715	7.831	83.505
WU130	B3	VDS	18.111	10.851	93.05
WU131	B1	CRA	15.463	9.466	91.542
WU131	B1	FNPC	15.677	9.494	87.067
WU131	B1	VDS	17.272	10.294	92.99
WU131	B2	CRA	16.076	9.701	90.497
WU131	B2	FNPC	15.691	9.494	87.067
WU131	B2	VDS	17.286	10.294	92.99
WU131	B3	CRA	15.702	9.046	89.585
WU131	B3	FNPC	15.645	9.494	87.067
WU131	B3	VDS	17.24	10.294	92.99
WU131bis	B1	CRA	15.415	8.557	87.67
WU131bis	B1	FNPC	14.405	8.086	82.046
WU131bis	B1	VDS	17.581	10.358	90.725
WU131bis	B2	CRA	15.429	8.557	87.67
WU131bis	B2	FNPC	15.159	8.728	85.54
WU131bis	B2	VDS	17.283	9.423	92.201
WU131bis	B3	CRA	15.383	8.557	87.67
WU131bis	B3	FNPC	15.55	7.964	80.897
WU131bis	B3	VDS	16.887	9.753	91.575

WU132	B1	CRA	14.892	8.489	86.133
WU132	B1	FNPC	15.539	8.787	81.11
WU132	B1	VDS	17.665	9.927	91.671
WU132	B2	CRA	14.741	8.753	87.04
WU132	B2	FNPC	15.174	8.652	85.85
WU132	B2	VDS	18.032	10.02	88.639
WU132	B3	CRA	15.243	8.807	86.292
WU132	B3	FNPC	15.317	8.738	83.628
WU132	B3	VDS	15.908	9.084	90.179