

# New prediction equations for the Organic Matter digestibility of concentrates and by products used for ruminants

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# Context

-Concentrates and byproducts used for ruminant feeding correspond to a large diversity of plant species, organs and technological processes.

-Continuous challenge of improving the prediction of nutritive value of concentrates and by-products

# Aim

-To propose a set of new specific equations according to groups of feeds to predict accurately OM digestibility from chemical composition.



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# Modern story of Ruminant Feed concentrate evaluation in France:

1978: « Alimentation des Ruminants » (R.Jarrige & 25 co-W)  
= *no specific equations for Co and ByP*

1988: Updating with an english version  
= *no specific equations for Co and ByP*

2002/2004: Multispecies tables INRA-AFZ  
(French, English, Spanish, Chinese)  
= *5 specific equations for Co and ByP*

2018: last updating « Systali »  
= *responses, dynamic aspects, INRATION and PREVALIM → specific equations*



# Methods: Database

- Database of in vivo OMD and chemical values [Crude Protein (CP), Crude Fibre (CF), NDF and ADF and Fat]
- Data published in the literature or from the major feed tables
- 24 families of products:  
wheat, maize, barley, oats, rice, pea, horsebean, lupine, vetch, soybean, rapeseed, sunflower, palmkernel & coconut, cotton, peanut, linseed, beet and citrus pulp, apple & pear, potato and tomato, olive & grape.
- For each family, 0 to 5 sub-groups, when significant



# Methods: statistics

-Meta-analysis of variance-covariance with 3 qualitative factors: the data source (literature and tables), the family and type of product (sub-group) within families.

-Two sets of regressions :

(1) to predict NDF or ADF from CF,

(2) to predict OMD either from CF (2a) or from NDF or ADF (2b)

*(with CP and Fat or not as supplementary variables)*

-Outliers ? NormResidual > 3



# Results

1. Relationships between NDF, ADF and CF
2. Relationships between OMD and CF or NDF  
& discrimination of sub-groups/family
3. Comparaison of accuracy between OMD prediction
4. Explanation of the diversity of the relationships



# Results (1)

## 1. Diversity of the relationships between NDF, ADF and CF:

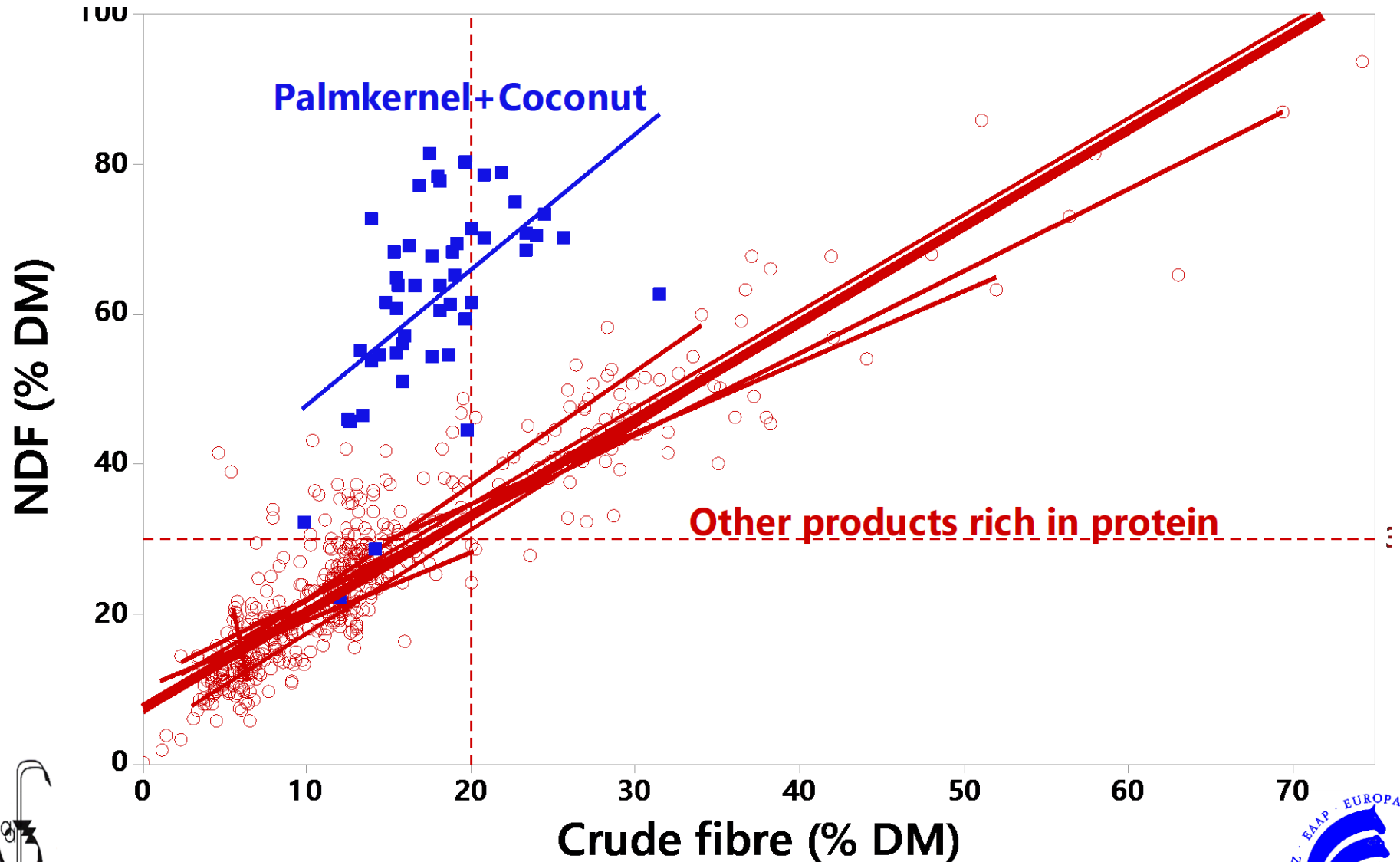
→ 42 regressions has been calculated to predict NDF and ADF contents from CF.

→ RSME were lower for ADF than NDF (10-20 vs 15-50 g/kg DM).

→ Calculated missing values of NDF and ADF for feeds with OMD and CF (10 to 20 % of data).

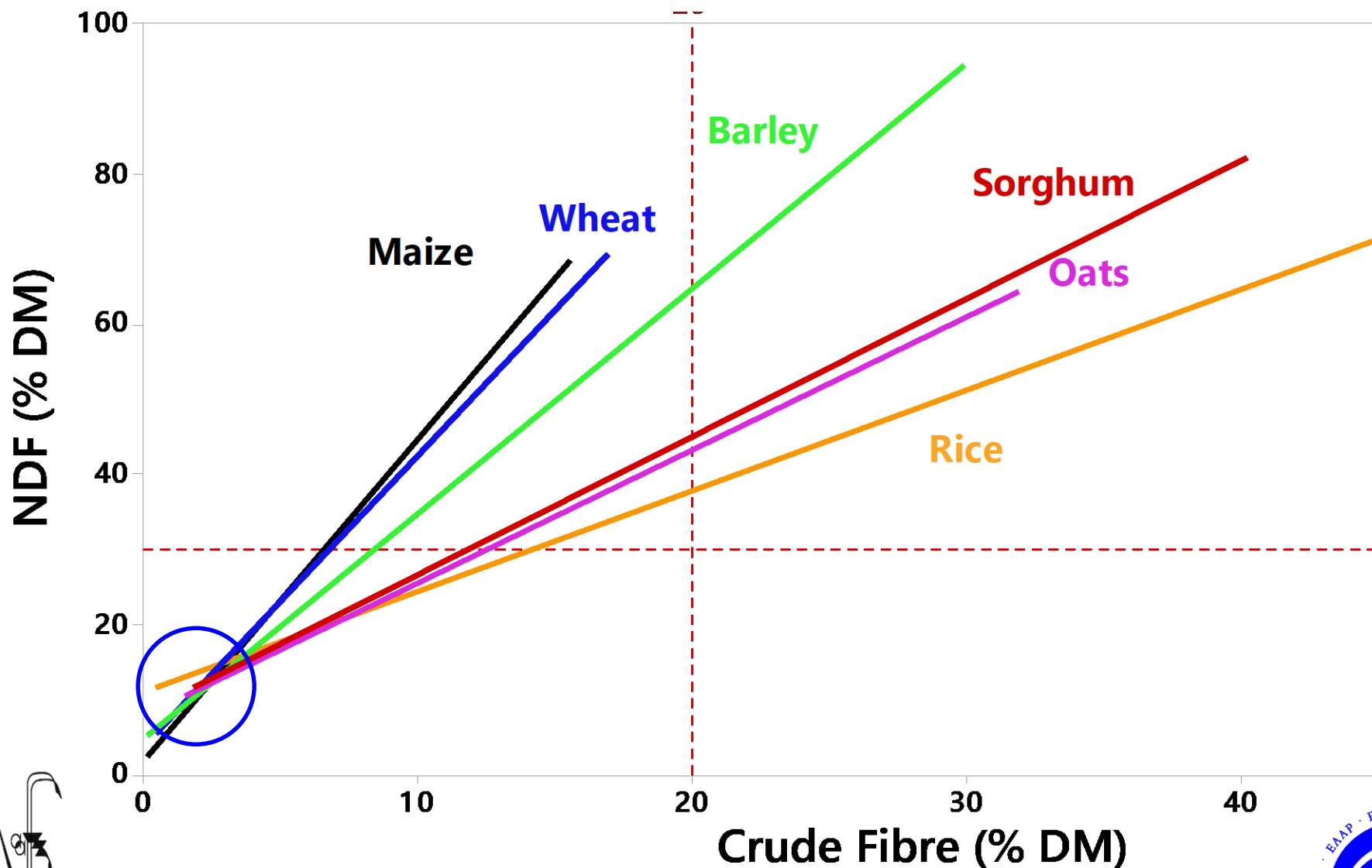


# Relationships between NDF and CF contents for products rich in proteins





# Relationships between NDF and CF contents for cereals and by-products



# Results (2)

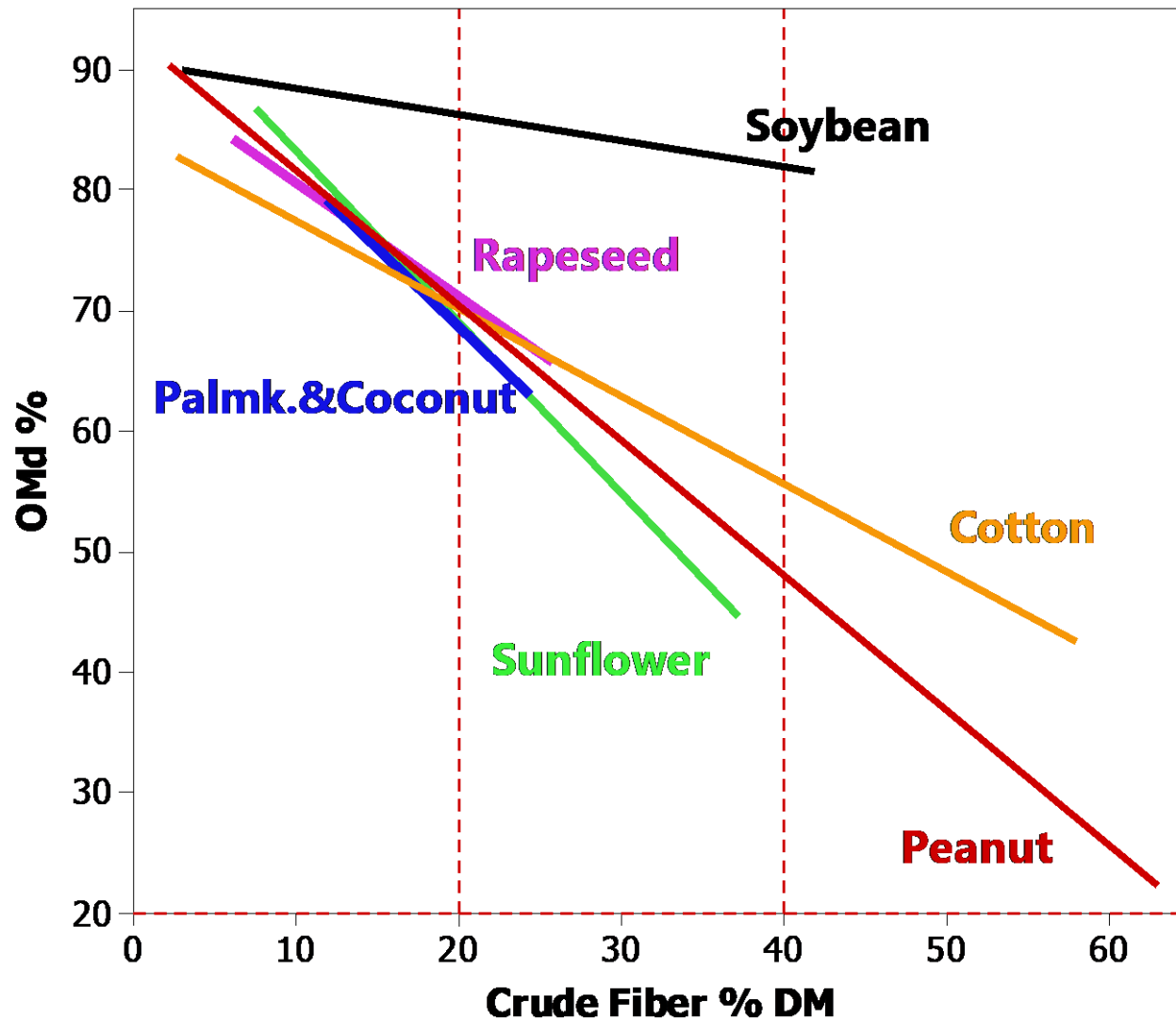
1. Diversity of the relationships between NDF, ADF and Crude Fibre

2. Diversity of the relationships between OMD and CF or NDF  
& Discrimination of sub-groups

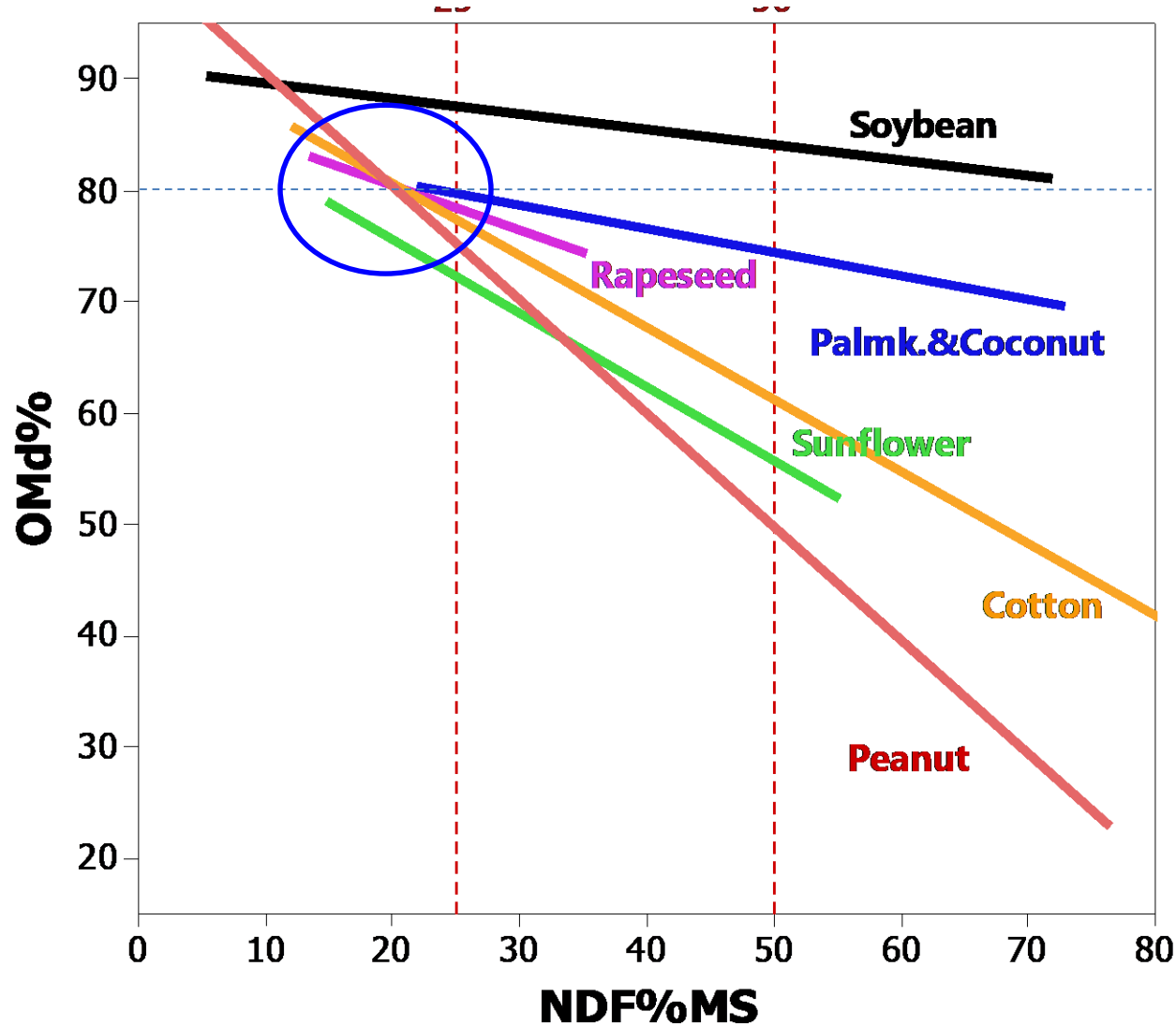
*82 regressions have been calculated with a RMSE range of 1.5-6.0 % point of digestibility.*



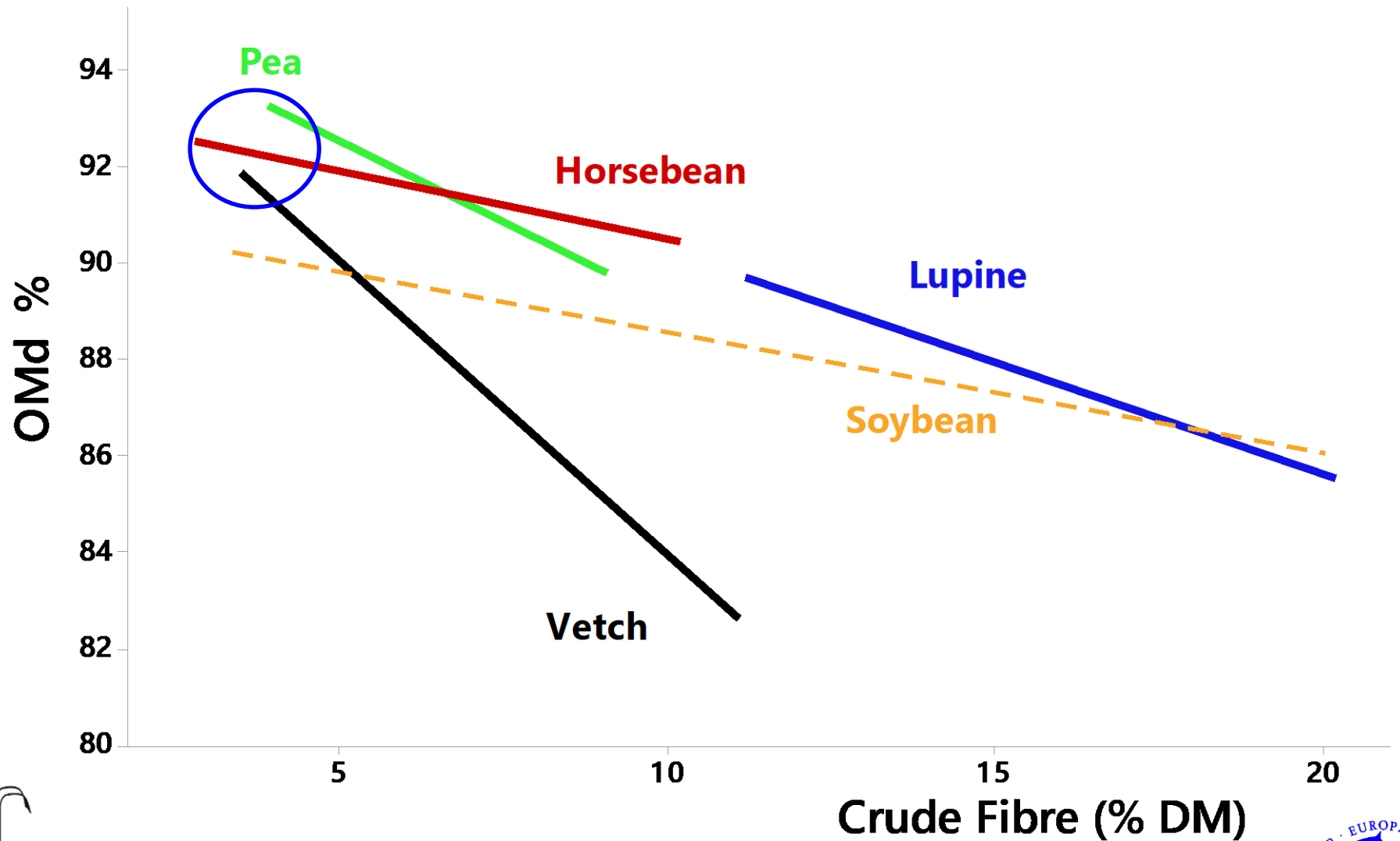
# Diversity of the relationships between OMD and CF contents for oilmeals



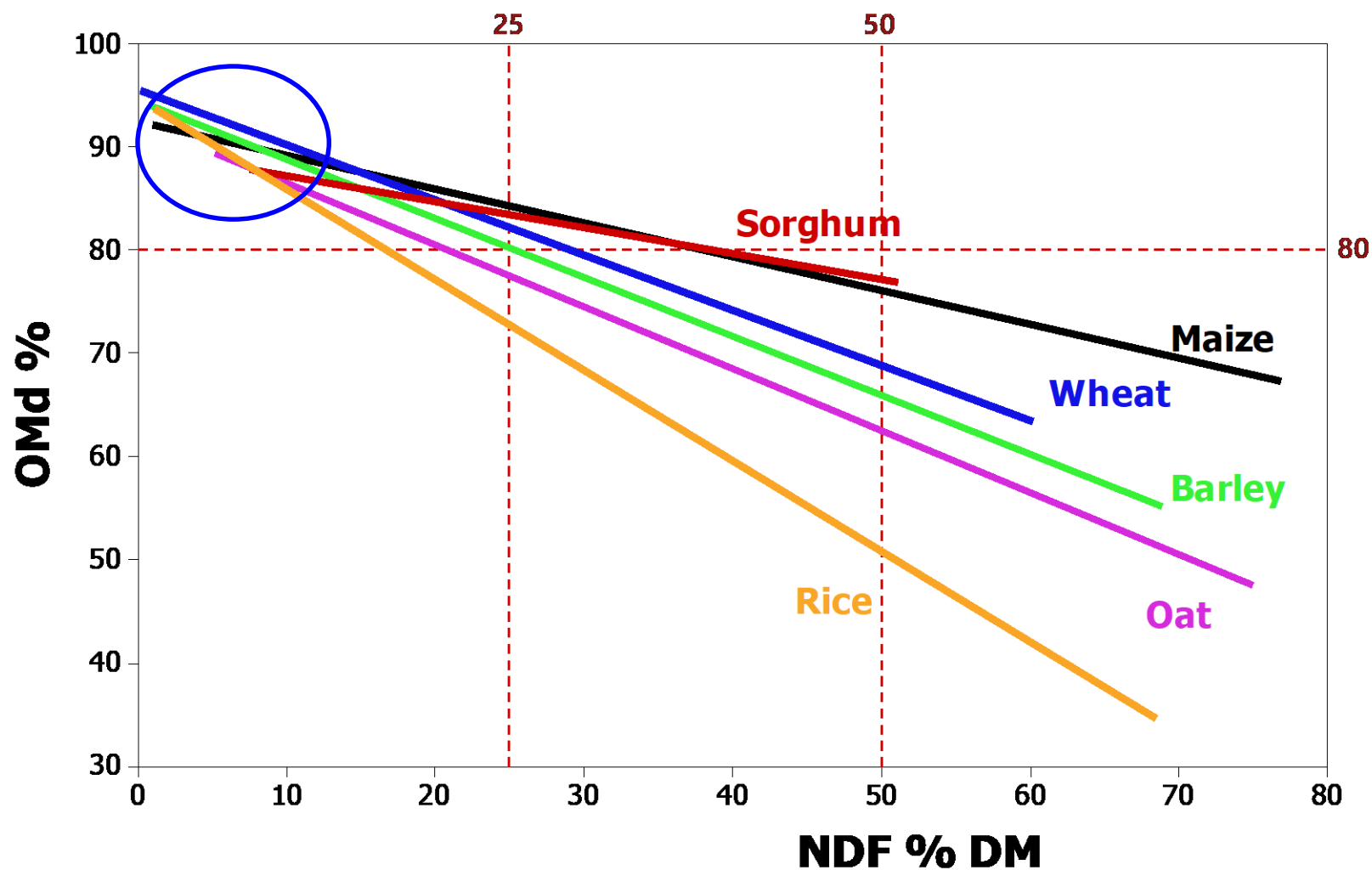
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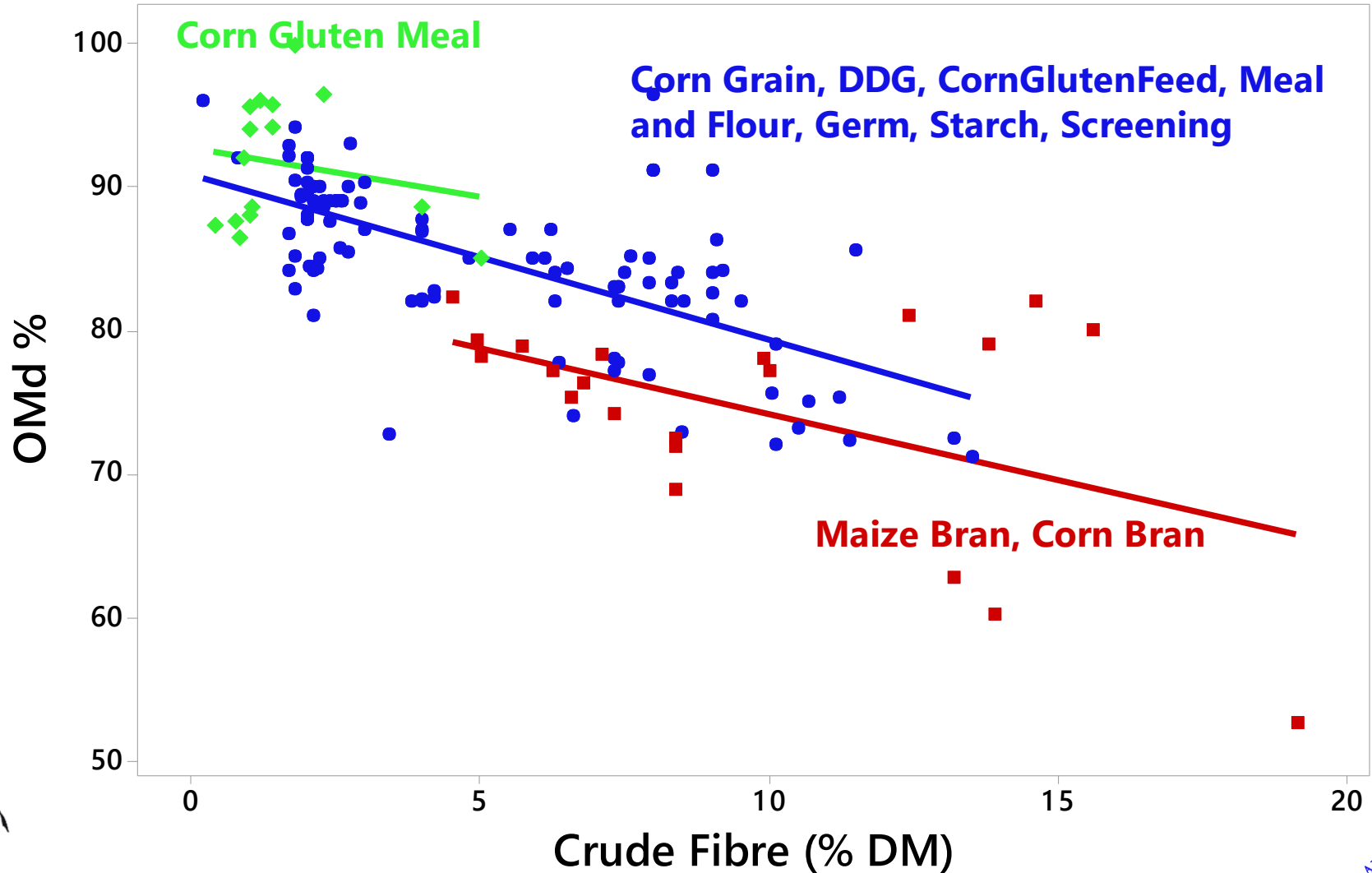
# Diversity of the relationships between OMD and CF contents for legumes



# Diversity of the relationships between OMD and NDF contents for cereal products



# Diversity of the relationships between OMd and CF contents for Maize products



Intercepts are different but not slopes → common value of  $-0.108$



# Example: Equations to predict OMD for Maize products

Independent item	Constant	Coef CF	Coef CP	CF±SD <sub>x</sub>	X2±SD <sub>x</sub>	Nb sources	Nb	R <sup>2</sup>	RMSE
CF	91.47(1)	-0.108		52.2±33.5		14	141	0.67	4.51
CF	88.30 (2)	-0.108		96.1±41.0		14	141	0.67	4.51
CF	94.07 (3)	-0.108		16.0±12.7		14	141	0.67	4.51
CF	94.07	-0.137	0.0060	68.0±50.3	201.5±163.5		101	0.55	4.97

- (1) Corn Grain, DDG, CornGlutenFeed, Meal and Flour, Germ, Starch, Screening
- (2) Maize Bran, Corn Bran
- (3) Corn Gluten Meal

Differences between feed tables ?



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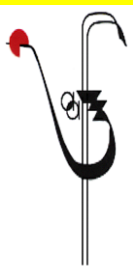
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CF	94.07	-0.137	0.00 60	68.0±50.3	201.5±163.5		101	0.55	4.97
NDF	91.38 (1)	-0.024		240.1±147.0		14	127	0.68	4.13
NDF	89.41 (2)	-0.024		415.3±134.5		14	127	0.68	4.13
NDF	93.0 (3)	-0.024		78.3±105.1		14	127	0.68	4.13
ADF	91.34 (1)	-0.007		74.2±53.4		11	117	0.63	4.77
ADF	88.51 (2)	-0.007		122.9±40.9		11	117	0.63	4.77
ADF	94.13 (3)	-0.007		24.31±30.6		11	117	0.63	4.77

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Differences between feed tables ?

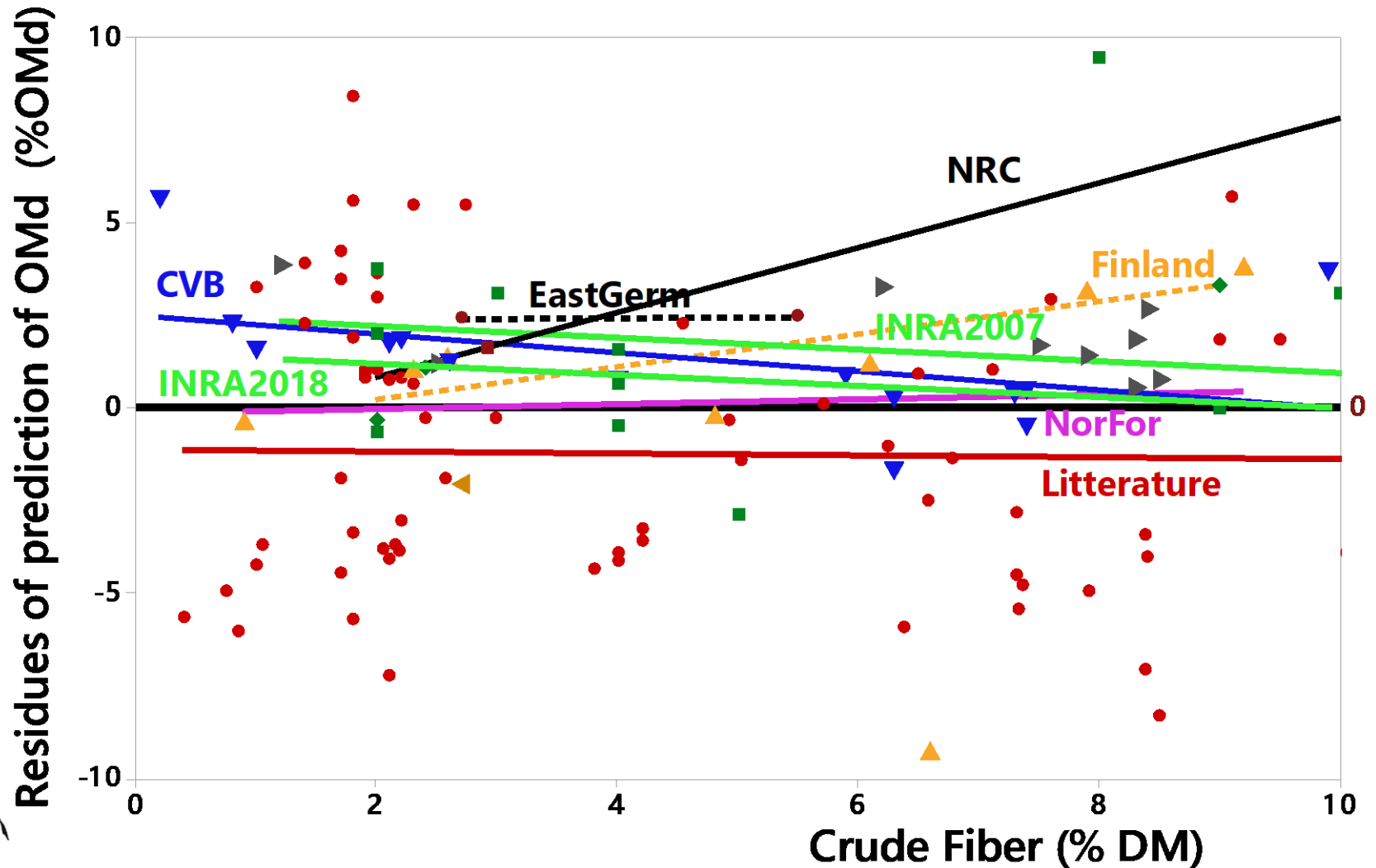
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# Products of maize: influence of data source on residual OMD predicted from CF and CP contents.

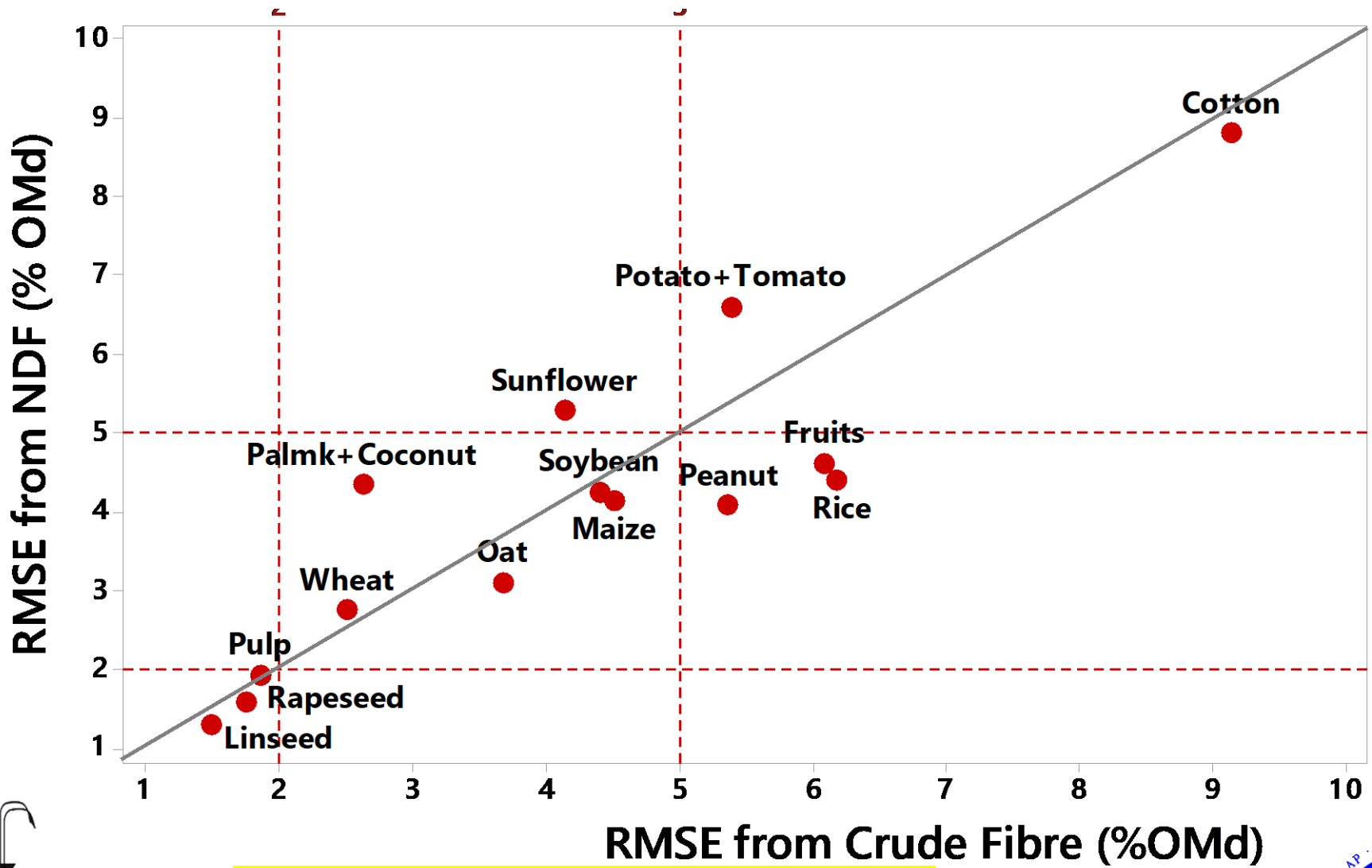


# Results (3)

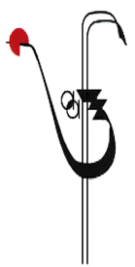
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# Comparison of precision of OMD prediction from either Crude Fibre or NDF contents



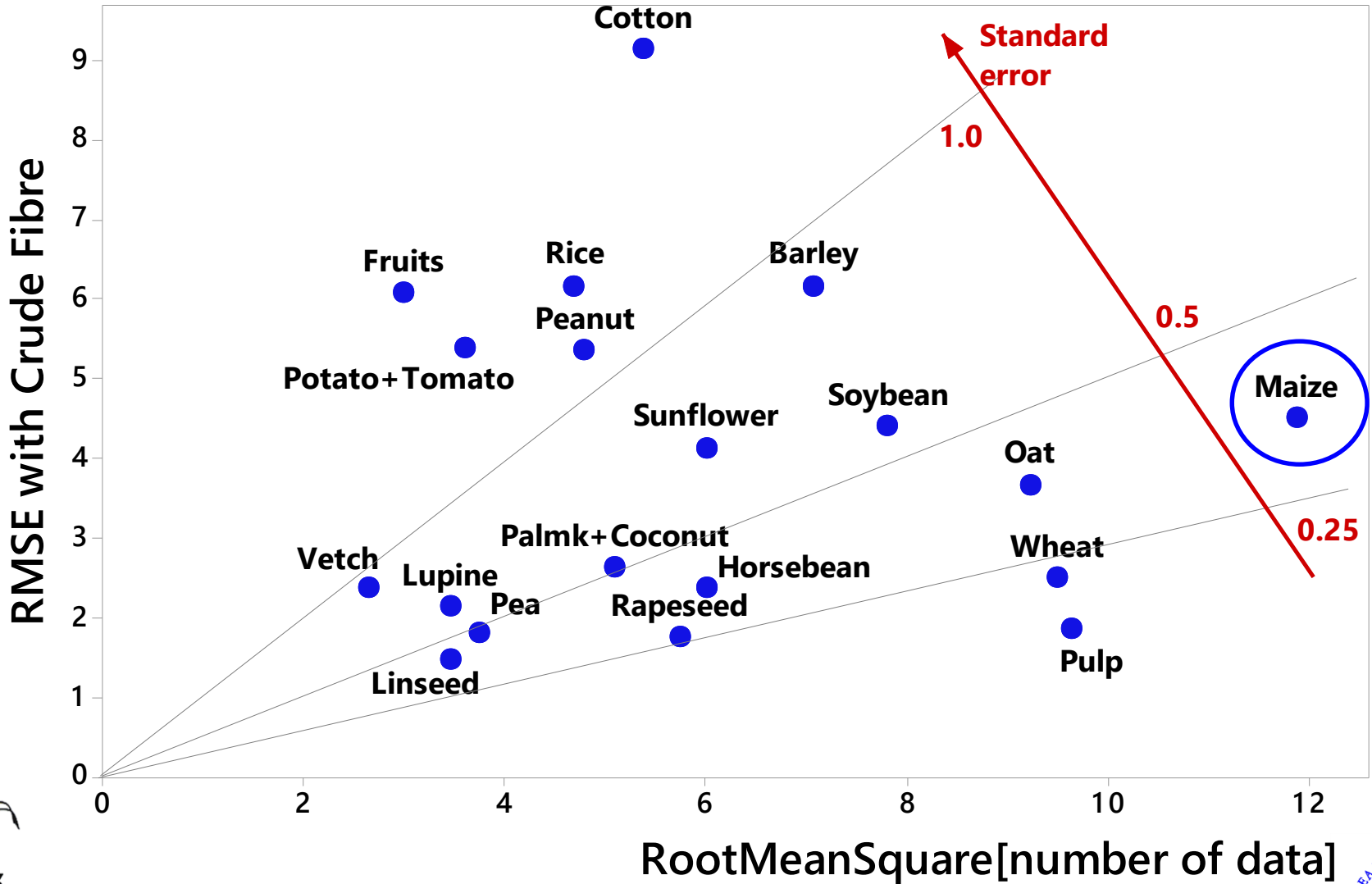
The two predictors are globally equivalent



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# Accuracy of prediction of OMD from Crude Fibre

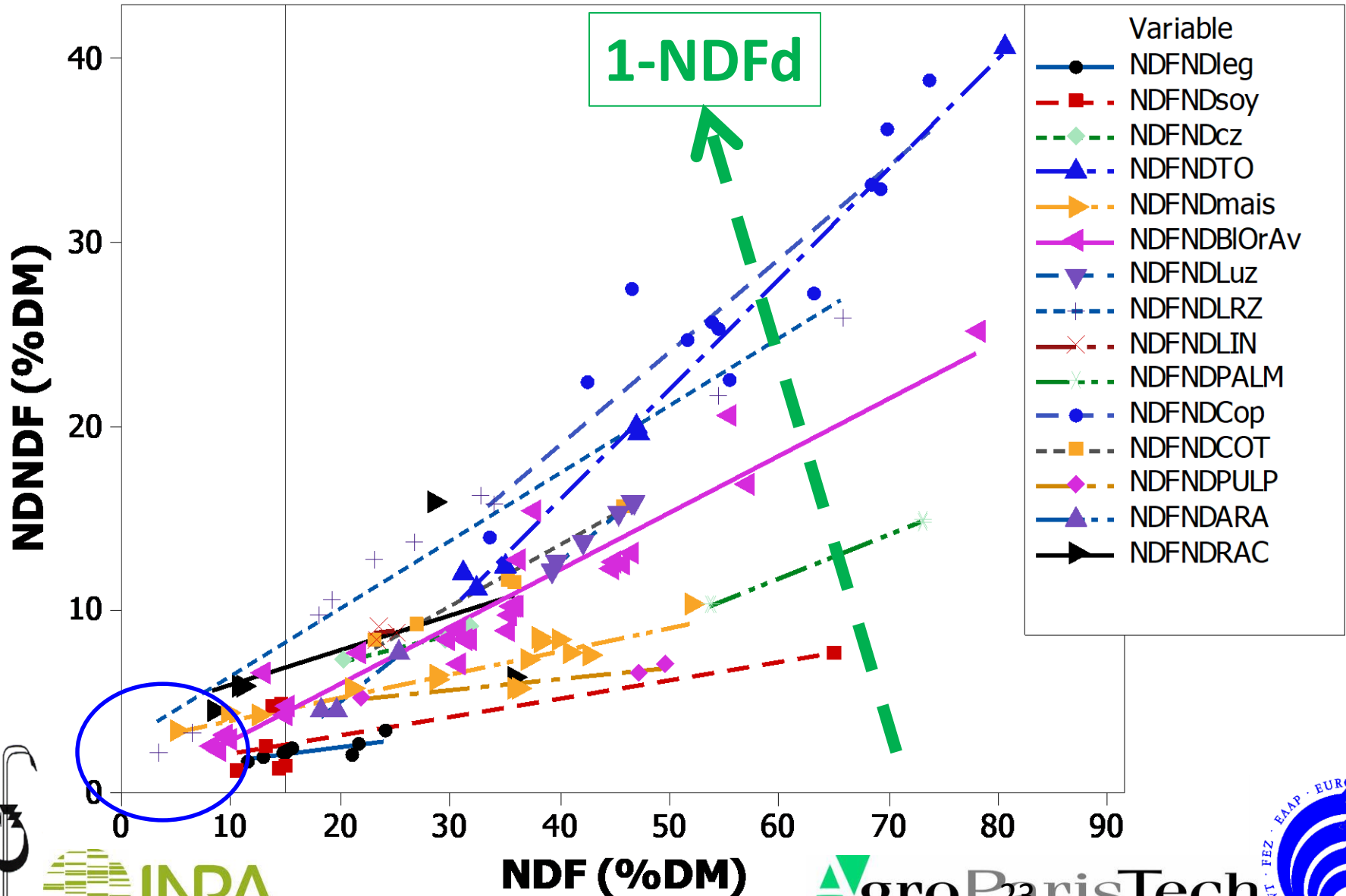


# Results (4)

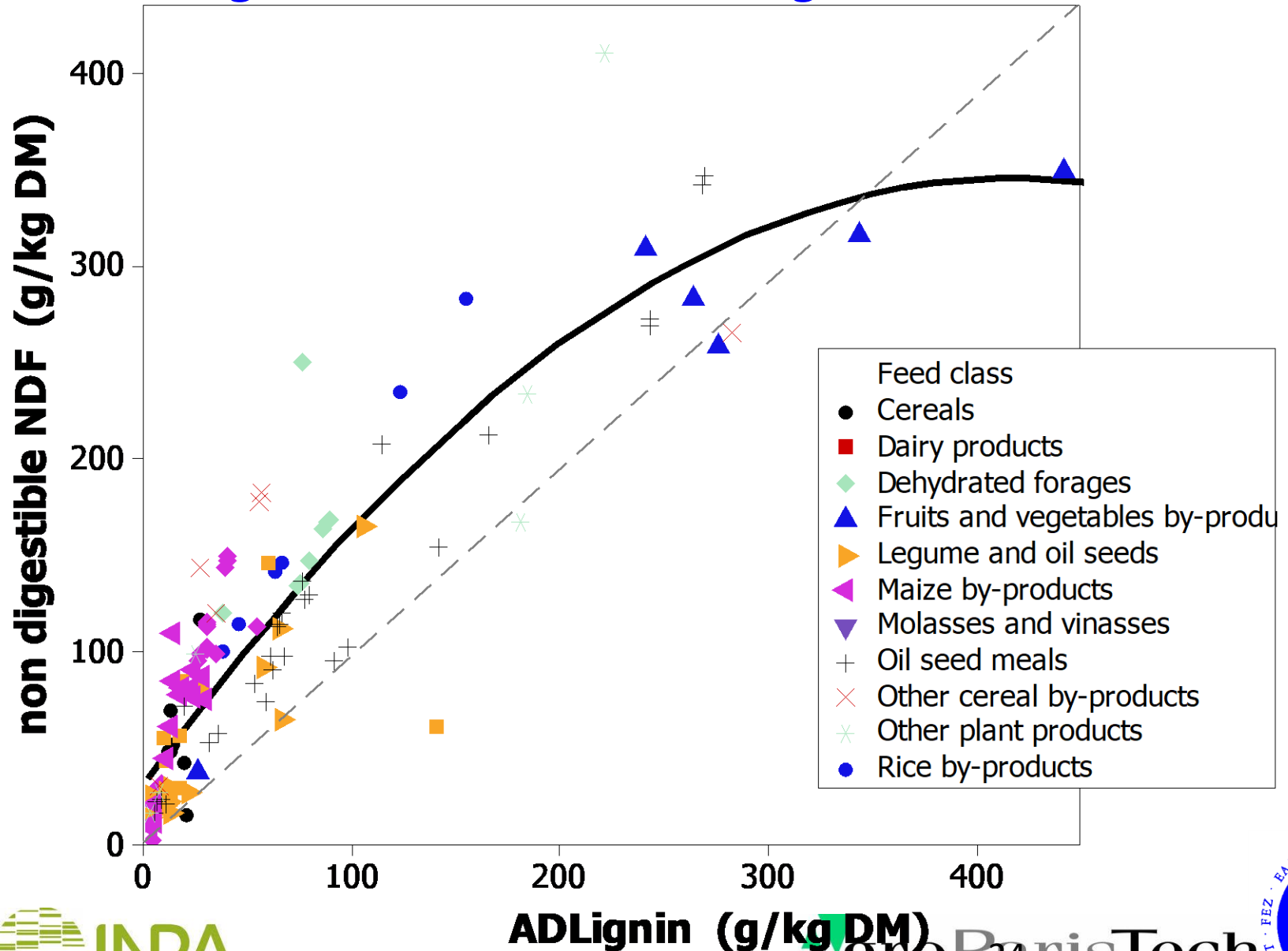
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# Diversity of the relationships between non digestible NDF and NDF contents



# Global relationship between non digestible NDF and ADLignin contents





# Conclusion

-Not "big science"...but a useful work :-)

-Relationships largely depend on nature of concentrate or cell wall:

-between CF, and NDF or ADF

-between OMD and CF, or NDF or ADF

-Some differences appeared between feed tables

-These results allow to predict precisely OMD and energy values for major concentrates and by products in ruminants

- The issue of the mixed concentrates ?



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