HGCA

PROJECT REPORT No. 111

NUTRITIVE VALUE OF WHEAT VARIETIES FED TO NON-RUMINANTS

MAY 1995

PRICE £5.00

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by

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This is the final report of an eighteen month project which commenced in October 1991. The work was funded by grants of £47,420 to the University of Nottingham (Part A) and £50,801 (Part B) from the Home-Grown Cereals Authority (Project No. 0057/1/91).

CONTENTS

1. INTRODUCTION

The current programme was conceived as a result of considerable disquiet within the feed industry that wheat was not of uniformly high nutritional value when fed to non-ruminants, particularly poultry, although evidence for such variability was almost entirely anecdotal and not supported by conclusive data. The programme has been centred around one principal area of study which is to evaluate routinely wheat varieties grown throughout the United Kingdom within trials organised by the National Institute of Agricultural Botany. Thus growing techniques were to a large extent controlled, with the exception of one trial where several varieties were grown at the same site with varying levels of nitrogen fertiliser. Evaluation was always with poultry (Apparent Metabolisable Energy, AME, conducted with young broilers at Nottingham, and True Metabolisable Energy, TME, conducted at Roslin with adult birds) although in some circumstances a sufficiently large sample size was available (from two commercial seed companies) to allow evaluation with pigs of Digestible Energy (DE), Metabolisable Energy (ME) and digestibility of nitrogen (DN). Wheats were harvested in 1991 and 1992.

Biological evaluation of wheats was accompanied by chemical measurements (proximate analyses together with starch), physical assessments (bushel weight and 1000 grain weight) 'Hagberg Falling Number' and, finally, Near Infra Red Spectroscopy (NIRS) conducted by J Bibby of Adderbury, Oxon. These physical measurements were employed in an attempt to predict dietary energy value of wheat varieties. Considerably more detailed biochemical characterisation of some wheat varieties (those representing extremes of nutritional value) are being undertaken in a parallel study conducted at the University of Nottingham (0005/01/90).

In all cases, data within tables indicate the centre responsible for their determination.

2. WHEATS EVALUATED

Tables 1 and 2 present details of the wheat varieties obtained for evaluation, respectively for the 1991 and 1992 harvest years, together with the trials designed to evaluate them.

3. ANALYTICAL DATA

Proximate analyses and starch concentrations are presented in tables 3, 4, 5, 6, 7 and 8 respectively for trials 1, 2, 3, 4, (all 1991 harvest), 1 and 2 (both 1992 harvest).

The two chemical measurements which varied most were starch (ranging from 43 to 57%) and nitrogen. For the latter term, the range was between 1g and 24g/kg with the exception of the trial based upon different levels of nitrogen fertiliser during growth (table 6, trial 4 1991 harvest) where levels were as would be expected from such regimes.

4. DIETARY ENERGY VALUES

The basis for expressing dietary energy values of feedstuffs and diets for poultry has been metabolisable energy (ME). Traditionally, Apparent Metabolisable Energy (AME) has been used. This measurement is defined in terms of the quantity of energy consumed less that voided in the excreta. In recent years, True Metabolisable Energy (TME) has also been employed widely. This latter term takes account of the energy voided in the excreta which is not of immediate dietary origin. It is not proposed to comment further on the relative merits of the two measurements, except to mention that both are employed in assessments of nutritional value. Accordingly, it was considered appropriate at the outset to provide both sets of data. Dietary energy values for pigs are expressed in terms of Digestible Energy (DE).

4.1. TME of wheat

TME values are presented in tables 9, 10, 11, 12, 13 and 14 respectively for trials 1, 2, 3, 4, (all 1991 harvest), 1 and 2 (both 1992 harvest). In all cases, TME was determined with adult birds - in some cases young birds were also used and, in these cases, data are indicated as such. There did not appear to be major differences between varieties. Interestingly, TME data determined with younger birds appeared higher than corresponding figures obtained with older birds.

4.2. AME of wheat evaluated with young poultry

Conventionally, it has always been assumed that wheat may be evaluated directly without the need to incorporate it into a basal diet, as long as a comprehensive mineral and vitamin premix was included to meet requirements (50g/kg) and oil (50g/kg) to promote palatability. Wheats, accordingly, are included at 900g/kg, following milling through a hammer mill fitted with a 3mm screen to remove any variation in particle size and to avoid selection. Evaluation for AME was through the classical total collection procedure, employing birds aged from 11-14 days, and from assumptions relating to the dietary energy value of the oil added. Preliminary results revealed, however, that birds of this age were, almost invariably, unable to utilise wheat at such high rates of inclusion since copious amounts of creamy excreta were produced with accompanying low AME values (ranging from around 5 to 11 MJ/kg DM). It was considered that a more appropriate approach would be to reduce the rate of inclusion of wheat to 750g/kg and to include soya protein isolate, selected because it is almost devoid of carbohydrate, at 150g/kg.

The first trial in the series of evaluation was in fact based upon both rates of inclusion of wheat and assessed 8 wheats grown at 2 sites harvested in 1991. Data are presented in table 15. A considerable range in AME values was obtained, although it was apparent that data from trial 2a (1991) was inappropriate in terms of generation of AME values of practical relevance. Trial 2b (1991) produced what was considered to be an acceptable range of AME values in that there were data which would be broadly comparable with what would be expected of wheats in practice (e.g. figures of between 13.24 to 13.76 MJ/kg DM), but also provided evidence that some wheats were poorly utilised (e.g. AME values less than 11MJ/kg, and a sample with a value of 7.68 MJ/kg). It was therefore considered that 750g/kg would be a suitable rate of inclusion for subsequent studies, as a range of values would be most likely at this rate. What trial 2 (1991) did demonstrate was that AME of wheat for young poultry is variable and influenced by rate of inclusion.

Subsequent trials from the 1991 harvest evaluated 6 wheats grown at 3 sites (Trial 3) and 8 wheats grown at the same site but with varying levels of nitrogen fertiliser (0, 150, 200 kg/ha - Trial 4). Wheats from the 1992 harvest were evaluated in 2 trials, the first being with 10 wheats each grown at 5 sites (Trial 1), and the second being 8 wheats grown at 2 sites (Trial 2). AME data are presented in tables 15, 16, 17, 18 and 19 respectively for Trials 2, 3, 4, (1991), 1 and 2 (1992).

A common observation within all trials was the variability between replicates on the same treatment. A general problem with the programme of evaluation has been that there appears to be a bird effect, with this effect becoming more pronounced the poorer the nutritive value of the wheat in question.

No consistent pattern emerged from the AME data, however, which would allow definitive conclusions to be drawn. The influence of nitrogen fertiliser appeared negligible, and the effect of site of growth was marginal. There were certainly differences between individual wheat varieties at specific sites, but the effect of site was not regular across varieties. In a comparison between harvest years when the same 8 varieties were grown (Trial 1b 1991 - table 15; trial 2 1992, table 19), it was evident that 1991 gave slightly higher data, although there were considerable variations between individual varieties. The response is summarised in figure 1.

The data did not provide clear evidence for a consistent effect of variety. However, when all data points were compared (see figure 2), there was a suggestion that variety was indeed having an effect, although again the comparison is not strictly valid (variations in the number of samples of each variety evaluated, varieties not balanced across years, sites and growing conditions). Data presented in figure 2 were employed in the selection of wheat samples for more detailed biochemical analysis (parallel HGCA programme 0005/01/90).

4.3. Relationship between TME (adult poultry) and AME (young poultry)

Variations obtained between samples in AME determined with young birds were not reflected in TME data generated with adult birds, with the latter, generally, being more uniform. The relationship between the two measurements is presented in figure 3 for some wheats evaluated from the 1991 harvest.

4.4. DE of wheat determined with growing / finishing pigs

Those wheats which were available in sufficient quantities were also evaluated with pigs. Data are presented in table 20 and 21 respectively for trial 2 (1991 harvest) and trial 2 (1992 harvest). Differences between extreme values were of the order of 1.2MJ/kg DM in 1991 and 1.5MJ/kg DM in 1992 (although the lowest value for 1992 was associated with a sample of low gross energy). In general, whilst this range is of some commercial relevance, it is probably not sufficiently great to warrant further examinations into the influence of either variety or year in DE values of unprocessed wheat for growing / finishing pigs (see figure 4). Metabolisable energy (ME) values were also determined (where both digestive and urinary losses are taken into account), but these reflected DE figures and are not reported

4.5. Relationship between AME (young poultry) and DE (growing / finishing pigs)

There did not appear to be any consistent pattern between AME and DE (see figure 5), in other words variation in AME was not reflected in that for DE.

4.6. Digestibility of nitrogen determined with pigs

There was a range in nitrogen contents of wheats obtained for evaluation with pigs, from 14.1 to 24.8g/kg dry matter, and nitrogen digestibility was determined. Coefficients of nitrogen digestibility are presented in tables 22 and 23 for trial 2 (1991) and trial 2 (1992) respectively. The coefficient is a more appropriate term to use in this context because the content of digestible nitrogen would be influenced by the total amount of nitrogen originally present in the sample. There appeared to be a positive correlation between nitrogen content and its digestibility (see figure 6). This is perhaps to be expected as an increase in nitrogen is usually associated with a specific increase in storage proteins which are presumably more accessible to digestive enzyme attack. What is of interest, however, is what the implications of this observation are for amino acids within the wheat, as it is known that an overall increase in grain protein is associated with increases in total amino acids, but a decrease in the concentration within the protein of those which are nutritionally essential. This topic is currently under examination in a parallel HGCA study (0016/01/92).

5. RELATIONSHIP BETWEEN DIETARY ENERGY VALUE AND PHYSICAL MEASUREMENTS

A simple physical test allowing the prediction of subsequent nutritional value would be of some considerable value to feed compounders. One of the major measurements of this sort undertaken with cereals is bushel weight, and 1000 grain weight has also been employed. Wheats from the 1992 harvest were assessed for both these terms.

The relationship between bushel weight and AME is presented in figure 7. It is evident that there is no correlation between the two terms, despite the fact that there was considerable variation in both. It has been suggested that the 1992 harvest was characterised by low bushel weight wheats, although the lowest sample obtained was 69.5 and the range extended up to

81.5, a value which would be associated with high quality wheat. It should be borne in mind that all samples were obtained from trial plots rather than from commercial sources, and this may have produced samples which were unrepresentative of the national harvest. However there is no evidence to suggest that there is any correlation between AME and bushel weight, as long as the latter is above 69.5. Samples which produced very low AME values (e.g. Trial 2, 1992: 9.89, 8.43, 9.29 and 9.43MJ/kg DM) had bushel weights of 71.0, 76.5, 76.0, and 78.5 respectively, which were not even at the low end of the range.

Assessments of 1000 grain weight revealed no correlation between this term and AME (figure 8). The link between the two measurements is not in fact regarded as being valid. Thus 1000 grain weight is variety specific (i.e. a variety with a characteristic small grain may, when well-filled, give a similar value as a variety with a large grain but poorly filled).

The 'Hagberg Falling Number' is employed routinely as a quality control measurement in the baking industry. There have been suggestions that it may be linked to nutritional value. However, selected wheat samples from the 1992 harvest, giving AME values of 8.43, 9.43, 12.63, 12.00, 11.22 and 9.89 had Hagberg Falling Numbers (determined at the Flour Milling and Baking Research Association) of 410, 384, 334, 306, 391 and 298 respectively. It is evident (figure 9) that the two measurements are not linked.

Near Infra-Red Spectroscopy (NIRS) is a technology that is assuming considerable importance in the analysis of raw materials in, amongst other things, animal feeds. All wheat samples which had been evaluated for AME (young poultry) were scanned by NIRS equipment at J Bibby, Adderbury, Oxon. Extensive assessments of spectra obtained, however, did not allow for meaningful relationships between them and AME to be derived.

6. SUMMARY / CONCLUSIONS

A. Wheats grown during the 1991 and 1992 harvest were evaluated for starch and proximate composition together with dietary energy (Apparent Metabolisable Energy, AME in young poultry; True Metabolisable Energy, TME in adult and young poultry; Digestible Energy, DE, in growing / finishing pigs) and nitrogen digestibility in growing / finishing pigs.

B. Starch and nitrogen levels varied considerably.

C. TME data indicated no meaningful variation attributable to variety, year of growth, location of growth or nitrogen fertiliser. TME data obtained with old birds was generally higher than that from young birds and the latter were associated with greater variability.

D. AME values were dependent upon the rate of inclusion of wheat in diets. AME data varied considerably between individual samples, although there was no clear evidence associating extreme values with specific named varieties. A possible effect of season was identified, but the influence of nitrogen fertiliser was negligible. The effect of site of growth was variable.

E. There was little correlation between TME (old and young) and AME

F. DE values differed significantly between varieties, but not in a consistent pattern. The effect of season and location of growth appeared small. There was evidence that nitrogen digestibility improved with total nitrogen content.

G. There were no correlations obtained between AME and proximate analysis, bushel weight, 1000 grain weight or Hagberg Falling Number. In addition the use of NIRS to predict AME was unsuccessful.

TABLE 1. Varieties evaluated from 1991 harvest

Trial 1

Varieties	Haven, Mercia, Riband, Hereward, Tallon, Admiral, Estica, Hussar, Beaver	
Sites	Cambridge, Headley Hall, Bridgets, Bush (SAC)	
Species	Poultry	AME (young) Nottingham 900g wheat /kg
		TME (young) Roslin
		TME (old) Roslin

Trial 2

Varieties	Admiral, Avalon, Beaver, Haven, Hereward, Mercia, Riband, Tara	
Sites	1 and 2 (Not Named)	
Species	Poultry	AME (young) Nottingham 900 and 750g wheat /kg
		TME (young) Roslin
		TME (old) Roslin
	Pigs	DE, ME, Nitrogen digestibility (Nottingham)

Trial 3

Varieties	Apollo, Galahad, Pastiche, Axial, Tara, Torfrida,	
Sites	Cambridge, Headley Hall, Bridgets	
Species	Poultry	AME (young) Nottingham 750g wheat /kg
		TME (young) Roslin
		TME (old) Roslin

Trial 4

Varieties	Riband, Galahad, Hornet, Norman, Beaver, Longbow, Slejpner, Sperber	
Sites	Northern Ireland	
Nitrogen	0, 150, 200 kg/ha	
Species	Poultry	AME (young) Nottingham 750g wheat /kg
		TME (young) Roslin
		TME (old) Roslin

TABLE 2. Varieties evaluated from the 1992 harvest

Trial 1

Varieties	Spark, Hunter, Haven, Hussar, Brigadier, Admiral, Beaver, Hereward, Riband, Mercia	
Sites	Cambridge, Headley Hall, Bridgets, Bush, Belfast	
Species	Poultry	AME (young) Nottingham
		TME (young) Roslin
		TME (old) Roslin

Trial 2

Varieties	Admiral, Avalon, Beaver, Haven, Hereward, Mercia, Riband, Tara	
Sites	1 and 2 (Not Named)	
Species	Poultry	AME (young) Nottingham
		TME (young) Roslin
		TME (old) Roslin
	Pigs	DE, ME, Nitrogen digestibility (Nottingham)

TABLE 3. Analytical data (as fed) from wheats - TRIAL 1 1991 ROSLIN

CODE NO	WHEAT VARIETY	SITE	DM g/kg	N g/kg	STARCH %	ASH g/kg	GE kJ/g
2034	HAVEN	CAMBRIDGE	872.6	23.5	47.63	14.1	16.37
2035	MERCIA	"	873.5	21.2	53.49	14.7	16.37
2036	RIBAND	"	870.3	19.3	51.19	14.6	16.43
2037	HEREWARD	"	875.4	22.3	54.76	14.1	16.40
2038	TALLON	"	873.8	19.7	49.57	13.6	16.24
2039	ADMIRAL	"	870.1	18.8	53.98	14.2	16.22
2040	ESTICA	"	874.0	20.0	53.49	13.9	16.28
2041	HUSSAR	"	873.1	19.1	53.50	14.8	16.23
2042	BEAVER	"	870.1	22.2	55.87	13.7	16.29
2043	HAVEN	H.HALL	875.6	20.0	47.59	15.5	16.31
2044	MERCIA	"	875.2	20.3	51.92	15.8	16.30
2045	RIBAND	"	870.9	17.1	51.68	15.3	16.24
2046	HEREWARD	"	871.6	23.3	49.78	14.8	16.33
2047	TALLON	"	876.2	22.4	49.90	15.0	16.34
2048	ADMIRAL	"	871.4	21.7	53.41	16.1	16.10
2049	ESTICA	"	877.4	20.7	50.63	15.0	16.23
2050	HUSSAR	"	875.7	19.8	53.49	14.3	16.20
2051	BEAVER	"	866.3	19.7	55.30	14.4	16.20
2052	HAVEN	BRIDGETS	872.5	21.5	50.54	14.7	16.34
2053	MERCIA	"	874.2	22.3	49.64	19.0	16.34
2054	RIBAND	"	875.6	20.6	51.31	17.2	16.29
2055	HEREWARD	"	873.1	23.0	51.09	16.1	16.35
2056	TALLON	"	881.7	21.1	49.85	15.8	16.42
2057	ADMIRAL	"	872.0	20.2	53.31	17.2	16.28
2058	ESTICA	"	881.2	21.7	52.29	15.7	16.26
2059	HUSSAR	"	883.2	19.1	51.04	15.7	16.24
2060	BEAVER	"	876.9	21.5	51.99	17.3	16.34
2061	HAVEN	BUSH	874.9	17.6	48.89	16.4	16.33
2062	MERCIA	"	873.2	19.3	49.90	15.2	16.29
2063	RIBAND	"	873.6	19.2	47.68	17.9	16.30
2064	HEREWARD	"	872.3	20.2	48.59	15.1	16.32
2065	TALLON	"	876.1	19.5	48.82	14.4	16.29
2066	ADMIRAL	"	874.7	20.0	48.05	16.0	16.29
2067	ESTICA	"	874.8	18.5	53.16	15.9	16.27
2068	HUSSAR	"	872.2	17.9	52.89	14.6	16.20
2069	BEAVER	"	871.9	18.3	54.21	16.7	16.31

TABLE 4. Analytical data (as fed) from wheats - TRIAL 2 1991 ROSLIN

CODE NO	WHEAT VARIETY	SITE	DM g/kg	N g/kg	STARCH %	ASH g/kg	GE kJ/g
2180	ADMIRAL	1	871.3	18.7	54.29	14.6	16.20
2181	HAVEN	"	873.2	20.6	53.33	15.1	16.26
2182	HEREWARD	"	874.7	19.9	53.65	14.1	16.25
2183	RIBAND	"	873.4	19.3	53.75	16.7	16.25
2184	BEAVER	"	875.1	18.5	52.85	18.5	16.13
2185	TARA	"	876.5	17.2	52.59	16.0	16.20
2186	MERCIA	"	870.7	16.8	56.62	16.4	16.11
2187	AVALON	"	874.9	21.9	54.69	17.6	16.29
2188	ADMIRAL	2	869.3	18.6	56.01	15.8	16.03
2189	HAVEN	"	872.7	18.5	55.75	16.2	16.21
2190	HEREWARD	"	876.0	21.8	55.49	15.6	16.33
2191	RIBAND	"	876.5	17.7	52.60	17.7	16.27
2192	BEAVER	"	881.5	20.2	52.16	17.0	16.31
2193	TARA	"	877.4	18.6	53.26	17.5	16.23
2194	MERCIA	"	885.9	19.1	55.80	17/5	16.21
2195	AVALON	"	875.7	18.1	54.58	16.4	16.19

TABLE 5. Analytical data (as fed) from wheats - TRIAL 3 1991 ROSLIN

CODE NO	WHEAT VARIETY	SITE	DM g/kg	N g/Kg	STARCH %	ASH g/kg	GE kJ/g
2159	APOLLO	CAMBRIDGE	889.6	22.0	53.96	13.1	16.41
2160	GALAHAD	"	889.2	20.9	50.34	13.3	16.43
2161	PASTICHE	"	888.8	23.7	51.30	14.9	16.43
2162	AXIAL	"	887.2	19.7	55.62	13.3	16.32
2163	TARA	"	885.9	19.9	45.00	13.8	16.39
2164	TORFRIDA	"	888.0	20.0	53.92	14.0	16.30
2165	APOLLO	H.HALL	889.2	21.5	53.59	15.6	16.32
2166	GALAHAD	"	887.3	20.6	52.03	16.0	16.29
2167	PASTICHE	"	891.7	22.4	48.39	16.1	16.40
2168	AXIAL	"	892.9	20.0	49.56	15.7	16.39
2169	TARA	"	892.0	20.6	52.76	15.3	16.41
2170	TORFRIDA	"	890.4	20.8	54.75	15.1	16.32
2171	APOLLO	BRIDGETS	892.0	20.5	54.97	16.1	16.34
2172	GALAHAD	"	890.0	21.3	55.61	17.3	16.37
2173	PASTICHE	"	895.2	23.8	49.05	17.2	16.39
2174	AXIAL	"	886.6	21.5	52.61	16.5	16.23
2175	TARA	"	889.2	18.6	51.58	16.4	16.37
2176	TORFRIDA	"	888.1	20.4	54.61	17.3	16.45

TABLE 6. Analytical data (as fed) from wheats - TRIAL 4 1991 ROSLIN

CODE NO	WHEAT VARIETY	N REGIME	DM g/kg	N g/kg	STARCH %	ASH g/kg	GE kJ/g
2196	RIBAND	0	865.8	11.7	57.37	15.8	15.99
2197	GALAHAD	"	868.1	13.8	51.95	15.5	15.97
2198	HORNET	"	866.0	12.4	57.55	13.9	15.81
2199	NORMAN	"	870.6	13.8	56.77	14.0	15.90
2200	BEAVER	"	870.2	12.6	56.97	14.3	15.79
2201	LONGBOW	"	870.1	13.2	52.76	17.4	15.91
2202	SLEJPNER	"	867.3	13.2	58.67	14.4	15.83
2203	SPERBER	"	869.1	14.8	55.10	14.8	16.04
2204	RIBAND	150	868.0	14.9	57.24	13.4	16.03
2205	GALAHAD	"	870.0	15.0	58.73	11.5	15.87
2206	HORNET	"	866.6	13.5	55.73	12.2	15.92
2207	NORMAN	"	870.0	16.0	54.52	13.4	16.09
2208	BEAVER	"	873.3	14.7	48.63	13.6	15.92
2209	LONGBOW	"	875.5	14.2	43.02	13.3	15.98
2210	SLEJPNER	"	875.3	15.4	53.39	14.8	16.02
2211	SPERBER	200	872.2	17.9	47.29	14.8	16.22
2212	RIBAND	"	873.1	16.2	45.78	14.9	16.12
2213	GALAHAD	"	872.1	17.4	51.23	15.4	16.10
2214	HORNET	"	860.9	16.4	47.24	14.4	15.96
2215	NORMAN	"	872.2	17.1	47.40	12.9	16.01
2216	BEAVER	"	874.3	16.2	54.57	13.7	16.03
2217	LONGBOW	"	874.9	17.2	51.26	14.1	16.09
2218	SLEJPNER	"	874.5	18.7	41.04	15.3	16.16
2219	SPERBER	"	872.8	18.7	44.91	13.1	16.17

TABLE 7. Analytical data (as fed) from wheats - TRIAL 1 1992 ROSLIN

WHEAT VARIETY	SITE	DM g/kg	N g/kg	STARCH g/kg	ASH g/kg	GE MJ/kg	OIL g/kg
SPARK	BUSH (SAC)	871.5	19.7	51.30	13.8	16.22	15.8
	BELFAST	869.3	19.2	48.38	13.1	16.14	17.8
	H.HALL	862.8	22.0	49.29	15.6	16.13	14.6
	BRIDGETS	859.8	22.3	50.13	13.6	16.35	16.3
	CAMBRIDGE	875.6	18.4	50.35	13.3	16.41	15.2
HUNTER	BUSH (SAC)	870.4	17.4	47.72	15.6	16.06	13.8
	BELFAST	871.2	18.2	45.16	14.5	16.10	16.5
	H.HALL	855.2	20.9	47.90	16.4	16.00	13.0
	BRIDGETS	870.7	21.3	47.81	15.3	16.08	14.1
	CAMBRIDGE	877.6	17.0	52.85	14.7	16.26	16.8
HAVEN	BUSH (SAC)	870.2	17.6	51.12	14.0	16.07	12.7
	BELFAST	873.4	17.8	50.04	14.2	16.02	14.7
	H.HALL	857.5	21.5	47.50	16.2	16.25	13.0
	BRIDGETS	861.8	19.9	49.00	14.6	16.30	13.0
	CAMBRIDGE	880.7	16.7	52.88	13.5	16.26	15.8
HUSSAR	BUSH (SAC)	871.1	16.5	54.12	13.6	15.98	13.3
	BELFAST	869.0	18.0	54.86	14.0	15.99	15.6
	H.HALL	857.5	19.8	49.78	14.7	15.99	11.6
	BRIDGETS	859.3	20.4	51.88	14.9	16.09	14.5
	CAMBRIDGE	878.6	18.4	51.48	14.4	16.23	13.5
BRIGADIER	BUSH (SAC)	866.6	16.6	52.72	14.3	15.94	13.1
	BELFAST	869.0	16.0	50.05	13.1	15.86	15.0
	H.HALL	858.8	19.0	53.69	17.7	16.06	13.3
	BRIDGETS	859.5	19.5	48.91	15.2	16.11	12.5
	CAMBRIDGE	877.8	18.0	52.59	13.6	16.21	13.6
ADMIRAL	BUSH (SAC)	868.9	16.7	49.05	13.2	16.42	12.3
	BELFAST	869.3	16.2	51.12	13.9	16.23	15.3
	H.HALL	861.3	19.1	48.14	16.0	15.44	10.9
	BRIDGETS	860.0	20.8	52.21	14.0	16.13	13.9
	CAMBRIDGE	879.6	17.6	51.97	16.7	16.23	16.6
BEAVER	BUSH (SAC)	874.3	20.4	50.41	14.6	16.29	12.7
	BELFAST	870.8	16.0	53.85	14.8	16.06	14.2
	H.HALL	859.7	21.2	50.66	17.4	16.17	12.1
	BRIDGETS	865.5	20.6	50.81	13.4	16.12	15.8
	CAMBRIDGE	878.5	17.5	53.43	14.9	16.19	15.4

HEREWARD	BUSH (SAC)	873.6	20.3	45.95	14.0	16.37	12.4
	BELFAST	869.3	17.3	46.07	12.4	16.18	13.2
	H.HALL	854.8	20.8	50.43	14.3	16.09	12.1
	BRIDGETS	856.4	21.8	48.16	13.3	16.08	12.2
	CAMBRIDGE	876.3	19.4	52.80	14.3	16.27	14.4
RIBAND	BUSH (SAC)	872.2	17.1	52.10	14.6	16.23	14.9
	BELFAST	873.2	17.8	47.07	14.8	16.17	16.4
	H.HALL	856.6	20.0	47.63	18.8	16.06	14.4
	BRIDGETS	861.1	21.6	54.17	14.7	16.15	14.4
	CAMBRIDGE	876.1	17.2	50.08	13.6	16.30	16.5
MERCIA	BUSH (SAC)	872.2	18.0	54.67	14.5	16.27	15.0
	BELFAST	872.2	19.1	54.57	14.6	16.26	15.5
	H.HALL	858.0	19.8	47.94	17.7	16.05	13.9
	BRIDGETS	858.5	21.3	54.02	12.6	16.09	14.6
	CAMBRIDGE	844.3	18.8	51.92	14.3	16.25	16.5

TABLE 8. Analytical data (as fed) from wheats - TRIAL 2 1992 ROSLIN

WHEAT VARIETY	SITE	DM g/kg	N g/kg	STARCH %	ASH g/kg	GE MJ/kg	OIL g/kg
ADMIRAL	1	857.0	19.3	49.89	14.3	16.20	14.4
	2	855.2	21.0	48.45	15.6	16.14	12.8
HAVEN	1	872.3	18.8	52.97	12.4	16.24	13.3
	2	859.5	18.5	46.36	14.4	16.02	12.0
HEREWARD	1	864.3	18.3	48.62	12.0	16.15	13.5
	2	857.8	19.1	50.81	14.7	16.07	14.3
RIBAND	1	876.9	22.0	51.57	12.0	16.46	14.5
	2	870.2	23.2	53.24	15.6	16.31	16.0
BEAVER	1	878.1	19.2	49.65	14.7	16.27	14.0
	2	862.9	18.4	48.57	15.9	16.11	12.6
TARA	1	869.2	18.0	49.40	12.9	16.18	15.9
	2	868.4	18.7	53.12	15.9	16.13	14.2
MERCIA	1	858.9	19.1	48.49	12.2	16.17	16.1
	2	873.6	21.9	52.20	16.1	16.27	14.0
AVALON	1	863.2	21.0	49.87	14.0	16.22	14.0
	2	863.6	20.4	46.65	15.5	16.16	12.6

TABLE 9. TME (MJ/kg DM) of wheat - TRIAL 1 1991 ROSLIN, POULTRY DATA

		Cambs	H Hall	Bridgets	Bush	Mean
HAVEN	adult	15.30±0.24	15.43±0.21	15.27±0.33	15.06±0.39	15.27
	young	15.51±0.53	16.13±0.62	15.77±0.68	15.70±1.00	15.78
MERCIA	adult	15.80±0.49	15.28±0.51	15.35±0.50	15.41±0.29	15.46
	young	16.64±0.20	15.30±1.13	15.77±0.68	15.87±0.66	15.90
RIBAND	adult	15.41±0.25	15.70±0.27	15.02±0.28	15.25±0.18	15.35
	young	15.48±0.19	15.66±0.33	15.04±0.37	15.93±0.61	15.53
HEREWARD	adult	15.44±0.21	15.57±0.30	15.39±0.31	15.24±0.54	15.41
	young	15.74±0.53	16.21±0.47	15.69±0.82	16.00±0.30	15.91
TALLON	adult	15.38±0.42	15.19±0.43	15.38±0.27	15.01±0.41	15.24
	young	15.71±0.85	15.06±0.57	15.65±0.61	15.33±0.19	15.44
ADMIRAL	adult	15.43±0.32	15.15±0.25	15.14±0.57	14.90±0.56	15.16
	young	15.95±0.54	15.73±0.41	15.41±0.91	15.30±0.69	15.60
ESTICA	adult	15.32±0.56	15.32±0.28	15.02±0.23	15.11±0.50	15.19
	young	15.94±0.16	15.63±1.24	15.26±0.51	16.30±0.70	15.78
HUSSAR	adult	15.45±0.39	15.02±0.42	15.07±0.38	15.10±0.47	15.16
	young	16.70±0.50	15.45±0.84	15.47±0.98	15.01±0.66	15.66
BEAVER	adult	15.63±0.56	15.59±0.41	15.06±0.29	14.91±0.35	15.30
	young	15.75±0.39	15.77±0.73	15.96±0.63	15.59±0.93	15.77
		15.52	15.41	15.21	15.12	
		16.05	15.74	15.63	15.75	

TABLE 10. TME (MJ/kg DM) of wheat - TRIAL 2 1991 ROSLIN, POULTRY DATA

		SITE A	SITE B	Mean
ADMIRAL	Adult	15.37±0.24	15.37±0.33	15.37
	Young	16.46±0.73	15.05±0.81	15.76
HAVEN	Adult	15.50±0.28	15.65±0.41	15.58
	Young	15.43±0.40	14.78±0.62	15.11
HEREWARD	Adult	15.58±0.34	15.58±0.23	15.58
	Young	15.01±0.68	15.24±0.47	15.13
RIBAND	Adult	15.52±0.24	15.38±0.30	15.45
	Young	14.96±0.94	15.33±0.57	15.14
BEAVER	Adult	15.01±0.14	15.50±0.44	15.25
	Young	15.06±0.39	15.02±1.18	15.04
TARA	Adult	15.53±0.41	15.28±0.33	15.41
	Young	-	15.90±0.46	15.90
MERCIA	Adult	15.72±0.34	15.46±0.40	15.59
	Young	15.51±0.45	14.72±0.54	15.12
AVALON	Adult	15.74±0.40	15.52±0.55	15.63
	Young	15.15±1.05	14.30±0.69	14.73
	Mean	15.50	15.47	
		15.37	15.04	

TABLE 11. TME (MJ/kg DM) of wheat - TRIAL 3 1991 ROSLIN, POULTRY DATA

		Cambs	H.Hall	Bridgets	Mean
APOLLO	Adult	15.13±0.32	15.52±0.34	15.49±0.23	15.38
	Young	15.69±0.61	15.94±0.78	15.67±0.50	15.89
GALAHAD	Adult	15.55±0.22	15.49±0.31	15.49±0.36	15.51
	Young	15.92±0.50	15.60±0.67	16.00±0.79	15.84
PASTICHE	Adult	15.68±0.10	15.42±0.16	15.21±0.33	15.44
	Young	16.06±0.42	15.10±0.91	15.62±0.43	15.59
AXIAL	Adult	15.65±0.29	15.48±0.33	15.41±0.39	15.51
	Young	15.86±0.53	15.44±0.87	15.45±0.49	15.58
TARA	Adult	15.82±0.41	15.40±0.43	15.26±0.29	15.49
	Young	16.42±0.54	15.44±0.68	15.67±0.56	15.84
TORFRIDA	Adult	15.51±0.36	15.41±0.39	15.72±0.17	15.55
	Young	15.78±0.63	15.51±0.84	15.93±0.49	15.74
		15.56	15.45	15.43	
		15.96	15.51	15.72	

TABLE 12. TME (MJ/kg DM) of wheat - TRIAL 4 1991 ROSLIN. POULTRY DATA

		O-N	15O-N	2OO-N	Mean
RIBAND	adult	15.43±0.36	15.58±0.38	15.50±0.15	15.50
	young	15.84±0.46	15.82±0.52	15.55±0.84	15.74
GALAHAD	adult	15.29±0.17	14.81±0.41	15.27±0.29	15.12
	young	15.36±0.49	16.09±0.61	14.96±0.66	15.47
HORNET	adult	15.23±0.27	15.36±0.41	15.63±0.24	15.41
	young	16.11±1.17	15.23±0.80	15.86±0.51	15.73
NORMAN	adult	14.66±0.69	15.73±0.37	15.38±0.31	15.25
	young	15.48±0.62	15.35±0.48	15.71±0.90	15.52
BEAVER	adult	15.31±0.33	15.41±0.42	14.82±0.48	15.18
	young	15.96±1.23	15.20±1.43	15.41±0.19	15.52
LONGBOW	adult	15.33±0.21	15.45±0.20	15.34±0.32	15.37
	young	15.59±0.84	16.26±0.57	16.22±0.69	16.02
SLEJPNER	adult	15.04±0.29	15.40±0.28	15.05±0.30	15.16
	young	16.34±0.84	15.77±0.56	15.06±0.65	15.72
SPERBER	adult	15.14±0.37	15.36±0.26	15.38±0.28	15.29
	young	14.85±0.64	15.71±1.21	15.07±0.74	15.21
	Mean	15.18	15.39	15.30	
		15.69	15.68	15.48	

TABLE 13. TME (MJ/kg DM) of wheat - TRIAL 1 1992 ROSLIN, POULTRY DATA

A. Adult

VARIETY	Bush	NI	SITE H.Hall	Bridgets	Cambs	Mean
SPARK	15.81	15.18	15.47	15.71	15.63	15.56
	±0.17	±0.23	±0.12	±0.46	±0.17	
HUNTER	15.27	15.31	15.33	15.06	15.51	15.30
	±0.37	±0.23	±0.09	±0.25	±0.30	
HAVEN	15.57	15.31	15.63	15.68	15.48	15.53
	±0.19	±0.21	±0.08	±0.23	±0.29	
HUSSAR	15.51	15.30	15.27	15.62	15.26	15.39
	±0.27	±0.20	±0.12	±0.28	±0.16	
BRIGADIER	15.60	15.22	15.58	14.98	15.49	15.37
	±0.11	±0.27	±0.32	±0.45	±0.36	
ADMIRAL	16.26	15.83	14.77	15.56	15.55	15.59
	±0.39	±0.27	±0.45	±0.18	±0.17	
BEAVER	15.92	15.54	15.48	15.77	15.52	15.65
	±0.30	±0.24	±0.17	±0.25	±0.18	
HEREWARD	15.79	15.81	15.56	16.14	16.03	15.87
	±0.23	±0.21	±0.19	±0.13	±0.40	
RIBAND	16.02	15.77	15.58	15.27	15.82	15.69
	±0.37	±0.12	±0.22	±0.18	±0.25	
MERCIA	15.88	15.60	15.62	15.89	16.40	15.88
	±0.30	±0.18	±0.26	±0.19	±0.08	
Mean	15.76	15.49	15.43	15.57	15.67	

A. Young

VARIETY	Bush	NI	H.Hall	Bridgets	Cambs	Mean
SPARK	14.38	14.97	14.89	15.89	16.46	15.32
	±0.56	±0.97	±0.67	±0.43	±0.72	
HUNTER	15.95	14.91	14.30	15.10	13.96	14.84
	±0.32	±0.91	±0.50	±0.69	±1.45	
HAVEN	14.63	14.99	14.13	15.71	14.83	14.86
	±0.69	±0.88	±1.42	±0.75	±1.17	
HUSSAR	15.42	13.48	15.65	13.95	14.84	14.67
	±0.75	±0.93	±0.90	±0.85	±0.65	
BRIGADIER	15.46	14.22	14.24	14.69	15.19	14.76
	±1.15	±0.90	±0.84	±0.82	±0.41	
ADMIRAL	15.07	14.56	14.48	15.21	14.62	14.79
	±1.19	±0.71	±1.04	±0.78	±0.93	
BEAVER	14.58	14.70	14.61	14.63	14.84	14.67
	±1.38	±0.93	±0.86	±0.87	±0.83	
HEREWARD	15.72	14.95	15.14	15.32	14.84	15.19
	±1.03	±0.99	±0.84	±0.71	±0.40	
RIBAND	14.88	15.55	14.92	15.93	15.14	15.28
	±0.73	±0.25	±0.71	±0.40	±1.07	
MERCIA	15.20	14.74	14.72	15.66	14.95	15.05
	±0.69	±0.45	±0.79	±0.96	±0.92	
Mean	15.13	14.68	14.71	15.21	14.97	

TABLE 14. TME (MJ/kg DM) of wheat - TRIAL 2 1992 ROSLIN, POULTRY DATA

VARIETY	ADULT			YOUNG		
	SITE 1	SITE 2	Mean	SITE 1	SITE 2	Mean
ADMIRAL	15.71 ±0.26	15.51 ±0.30	15.61	14.85 ±0.81	15.32 ±0.80	15.09
HAVEN	15.60 ±0.34	15.92 ±0.21	15.76	14.48 ±1.11	14.12 ±0.50	14.30
HEREWARD	15.78 ±0.41	15.99 ±0.16	15.89	14.58 ±0.56	14.85 ±1.08	14.72
RIBAND	15.81 ±0.36	15.61 ±0.32	15.71	15.50 ±0.88	15.24 ±0.47	15.37
BEAVER	15.47 ±0.08	15.82 ±0.25	15.65	14.60 ±1.04	14.86 ±0.60	14.73
TARA	16.00 ±0.29	15.79 ±0.22	15.90	14.39 ±1.47	14.69 ±0.90	14.54
MERCIA	15.89 ±0.21	15.66 ±0.31	15.78	15.48 ±0.37	13.98 ±0.60	14.73
AVALON	15.93 ±0.31	15.84 ±0.23	15.89	15.00 0.55	15.20 ±1.29	15.10
Mean	15.77	15.77		14.86	14.78	

TABLE 15. AME (MJ/kg DM) of wheat varieties as influenced by site of growth and means of evaluation - TRIAL 2 1991 NOTTINGHAM, POULTRY DATA

	Trial 1a (900g wheat/kg)			Trial 1b (750g wheat/kg)			
	Site			Site			Overall
	1	2	Mean	1	2	Mean	Mean
Admiral	8.78	11.56	10.17	12.72	13.56	13.14	11.65
Avalon	7.11	6.66	6.89	7.68	10.34	9.01	7.95
Beaver	10.46	7.73	9.09	13.24	12.11	12.67	10.89
Haven	8.85	8.74	8.80	13.45	11.04	12.25	10.52
Hereward	5.35	7.22	6.29	11.03	9.84	10.43	8.36
Mercia	6.50	8.12	7.31	13.73	13.03	13.38	10.35
Riband	9.39	7.99	8.69	13.76	13.58	13.67	11.18
Tara	6.94	10.77	8.85	13.55	11.86	12.71	10.78
Mean	7.92	8.60	8.26	12.40	11.92	12.16	

Factor	SEd	P=	Factor	SEd	P=
Varieties	0.57	<0.001	Variety x Trial	0.80	0.039
Site	0.28	0.729	Site x Trial	0.40	0.047
Trial	0.28	<0.001	Variety x Site x Trial	1.14	0.006
Varieties x Site	0.80	0.020			

TABLE 16. AME (MJ/kg DM) of wheat varieties as influenced by site of growth and means of evaluation - TRIAL 3 1991 NOTTINGHAM, POULTRY DATA

	Site			
Variety	**Bridgets**	**Cambridge**	**H. Hall**	**Mean**
Apollo	13.45	11.40	12.56	12.47
Axial	13.38	13.88	12.61	13.29
Galahad	13.86	12.93	13.74	13.51
Pastiche	13.41	13.67	13.64	13.57
Tara	13.38	12.59	11.07	12.35
Torfrida	13.31	12.74	13.08	13.05
Mean	13.47	12.87	12.79	13.04

Factor	SEd	P=
Varieties	0.430	0.016
Sites	0.304	0.056
Varieties x Sites	0.745	0.090

TABLE 17. AME (MJ/kg DM) of wheat varieties as influenced by level of nitrogen fertilisation - TRIAL 4 1991 NOTTINGHAM, POULTRY DATA

	N regime (kg/ha)			
Variety	**0**	**150**	**200**	**Mean**
Beaver	12.79	11.71	12.54	12.35
Galahad	12.94	13.68	12.64	13.08
Hornet	12.66	12.63	13.09	12.79
Longbow	13.10	13.29	13.11	13.17
Norman	12.87	12.15	13.16	12.73
Riband	12.12	11.83	12.41	12.12
Slejpner	11.38	11.94	12.60	11.98
Sperber	12.02	13.07	12.75	12.61
Mean	12.49	12.54	12.79	12.60

Factor	SEd	P=
Varieties	0.433	0.033
Nitrogen	0.247	0.428
Varieties x Nitrogen	0.698	0.591

TABLE 18. AME (MJ/kg DM); TRIAL 1 1992 NOTTINGHAM, POULTRY DATA

Variety	Site					
	NI	Bridgets	Cambs	H. Hall	Bush	Mean
Admiral	12.04	11.75	12.35	10.74	11.21	11.62
Beaver	11.40	10.90	11.89	11.33	10.51	11.21
Brigadier	11.84	11.20	12.11	11.05	12.45	11.73
Haven	11.88	12.25	9.92	11.97	9.97	11.20
Hereward	12.33	10.59	11.65	10.63	11.29	11.30
Hunter	10.49	10.77	12.00	11.00	11.61	11.18
Hussar	10.61	12.27	8.49	12.31	8.82	10.50
Mercia	11.54	11.49	10.88	11.85	12.18	11.59
Riband	11.43	11.34	11.27	11.21	12.42	11.54
Spark	11.20	11.38	11.47	10.82	11.24	11.22
Mean	11.48	11.40	11.20	11.29	11.17	

Factor	SEd	P=
Varieties	0.395	0.098
Sites	0.280	0.124
Varieties x sites	0.884	0.001

TABLE 19. AME (MJ/kg DM): TRIAL 2 1992 NOTTINGHAM, POULTRY DATA

	Site 1	Site 2	Mean
Admiral	9.89	12.00	10.95
Haven	8.43	11.22	9.82
Hereward	9.29	10.95	10.12
Riband	10.67	9.90	10.28
Beaver	11.41	11.32	11.37
Tara	12.63	9.43	11.03
Mercia	10.18	10.55	10.37
Avalon	11.76	11.97	11.87
Mean	10.53	10.92	

Factor	SEd	P=
Varieties	0.823	0.211
Sites	0.412	0.354
Varieties x sites	1.160	0.017

TABLE 20. DE (MJ/kg DM) of wheat varieties as influenced by site of growth - TRIAL 2 1991 NOTTINGHAM, PIG DATA

	Site 1	Site 2	Mean
Admiral	15.11	14.86	14.98
Avalon	15.13	14.85	14.99
Beaver	14.81	15.36	15.04
Haven	15.29	15.40	15.34
Hereward	15.24	15.34	15.29
Mercia	15.97	15.65	15.81
Riband	15.49	16.01	15.75
Tara	15.82	15.89	15.86
Mean	15.36	15.42	

Factor	SEd	P=
Varieties	0.134	<0.001
Sites	0.067	0.359
Varieties x sites	0.189	0.007

TABLE 21. DE (MJ/kg DM) of wheat varieties as influenced by site of growth; TRIAL 2 1992 NOTTINGHAM, PIG DATA

	Site 1	Site 2	Mean
Admiral	14.66	15.17	14.92
Haven	15.66	15.08	15.37
Hereward	15.79	15.19	15.49
Riband	14.96	15.85	15.40
Beaver	15.72	15.43	15.58
Tara	15.45	14.55	15.00
Mercia	16.01	15.42	15.72
Avalon	15.20	15.48	15.34
Mean	15.43	15.27	

Factor	SEd	P=
Varieties	0.184	<0.001
Sites	0.092	0.097
Varieties x sites	0.260	<0.001

TABLE 22. Coefficient of nitrogen digestibility (Nitrogen digested/nitrogen in diet) of wheat varieties as influenced by site of growth- TRIAL 2 1991 NOTTINGHAM , PIG DATA

	Site 1	Site 2	Mean
Admiral	0.843	0.824	0.834
Avalon	0.859	0.814	0.836
Beaver	0.844	0.877	0.861
Haven	0.845	0.860	0.853
Hereward	0.866	0.894	0.880
Mercia	0.821	0.844	0.853
Riband	0.853	0.851	0.852
Tara	0.868	0.865	0.866
Mean		0.850	0.858

Factor	SEd	P=
Varieties	0.014	0.052
Sites	0.007	0.234
Varieties x sites	0.020	0.020

TABLE 23. Coefficient of nitrogen digestibility (Nitrogen digested/nitrogen in diet) of wheat varieties as influenced by site of growth - TRIAL 2 1992 NOTTINGHAM, PIG DATA

	Site 1	Site 2	Mean
Admiral	0.846	0.853	0.850
Haven	0.859	0.854	0.857
Hereward	0.870	0.871	0.871
Riband	0.871	0.878	0.875
Beaver	0.834	0.830	0.832
Tara	0.855	0.851	0.853
Mercia	0.864	0.857	0.860
Avalon	0.855	0.863	0.859
Mean	0.857	0.857	

Factor	SEd	P=
Varieties	0.005	<0.001
Sites	0.002	0.851
Varieties x sites	0.007	0.574

FIGURE 1.

Varieties

A	Admiral	E	Hereward
B	Avalon	F	Mercia
C	Beaver	G	Riband
D	Haven	H	Tara

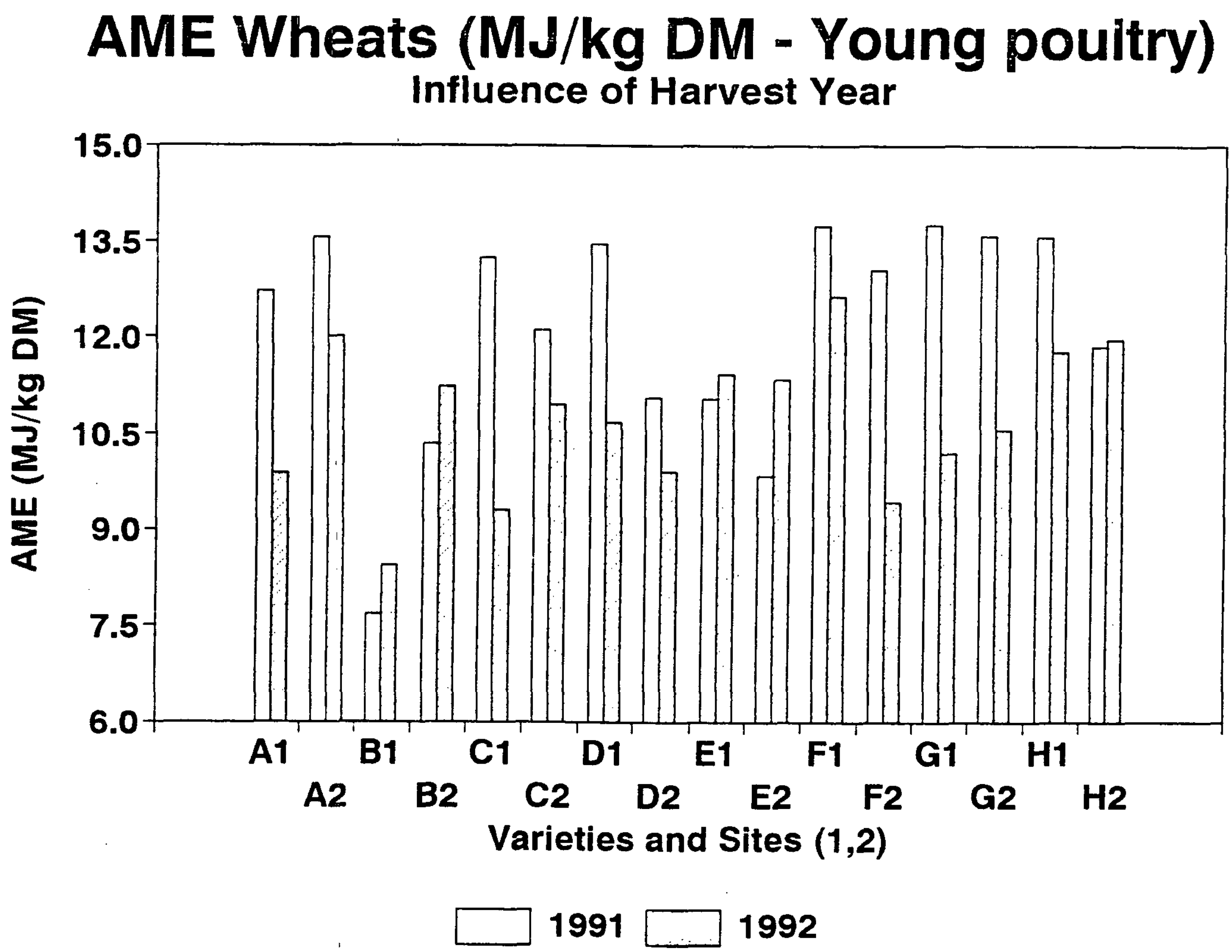


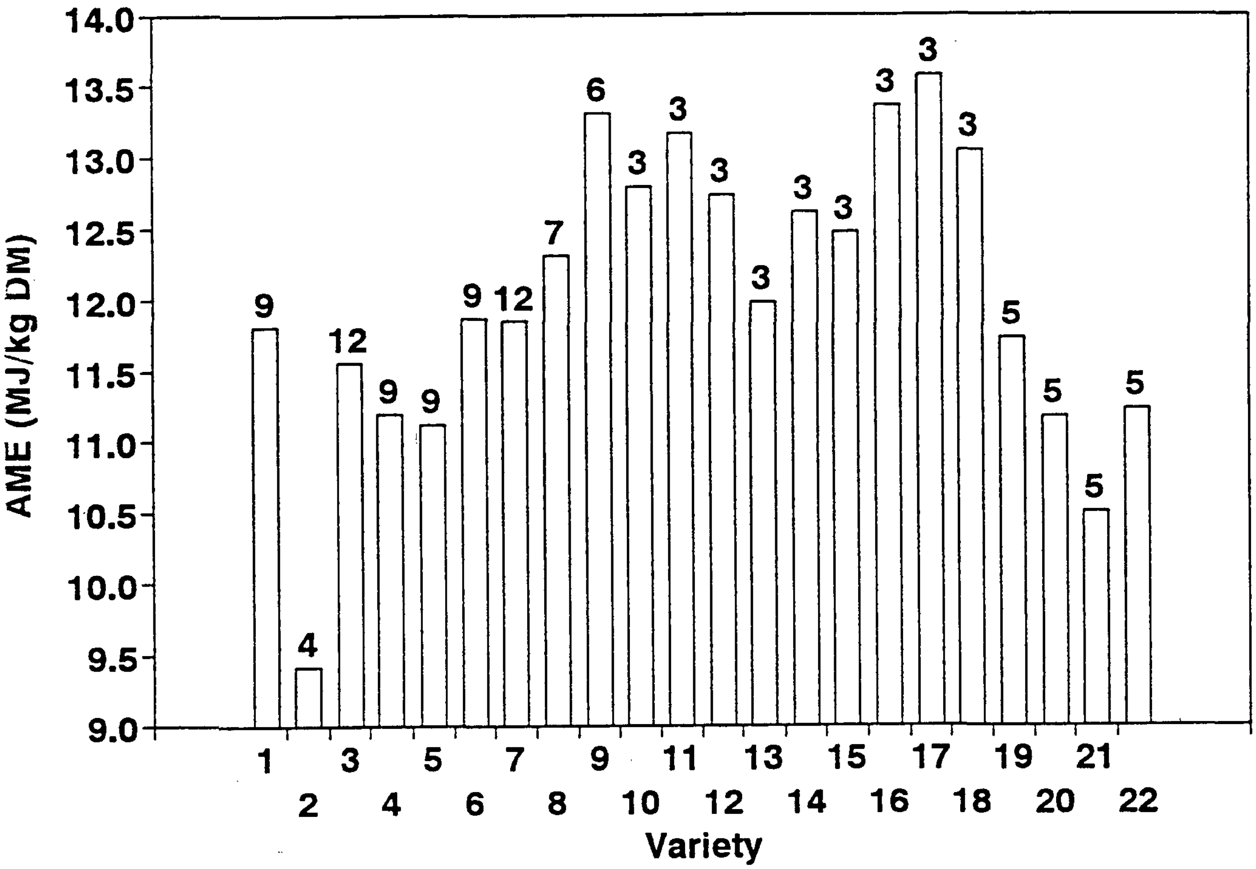
FIGURE 2.

Varieties

1	Admiral	9.	Galahad	16.	Axial
2.	Avalon	10.	Hornet	17.	Pastiche
3.	Beaver	11.	Longbow	18.	Torfreda
4.	Haven	12.	Norman	19.	Brigadier
5.	Hereward	13.	Slejpner	20.	Hunter
6.	Mercia	14.	Sperber	21.	Hussar
7.	Riband	15.	Apollo	22.	Spark
8.	Tara				

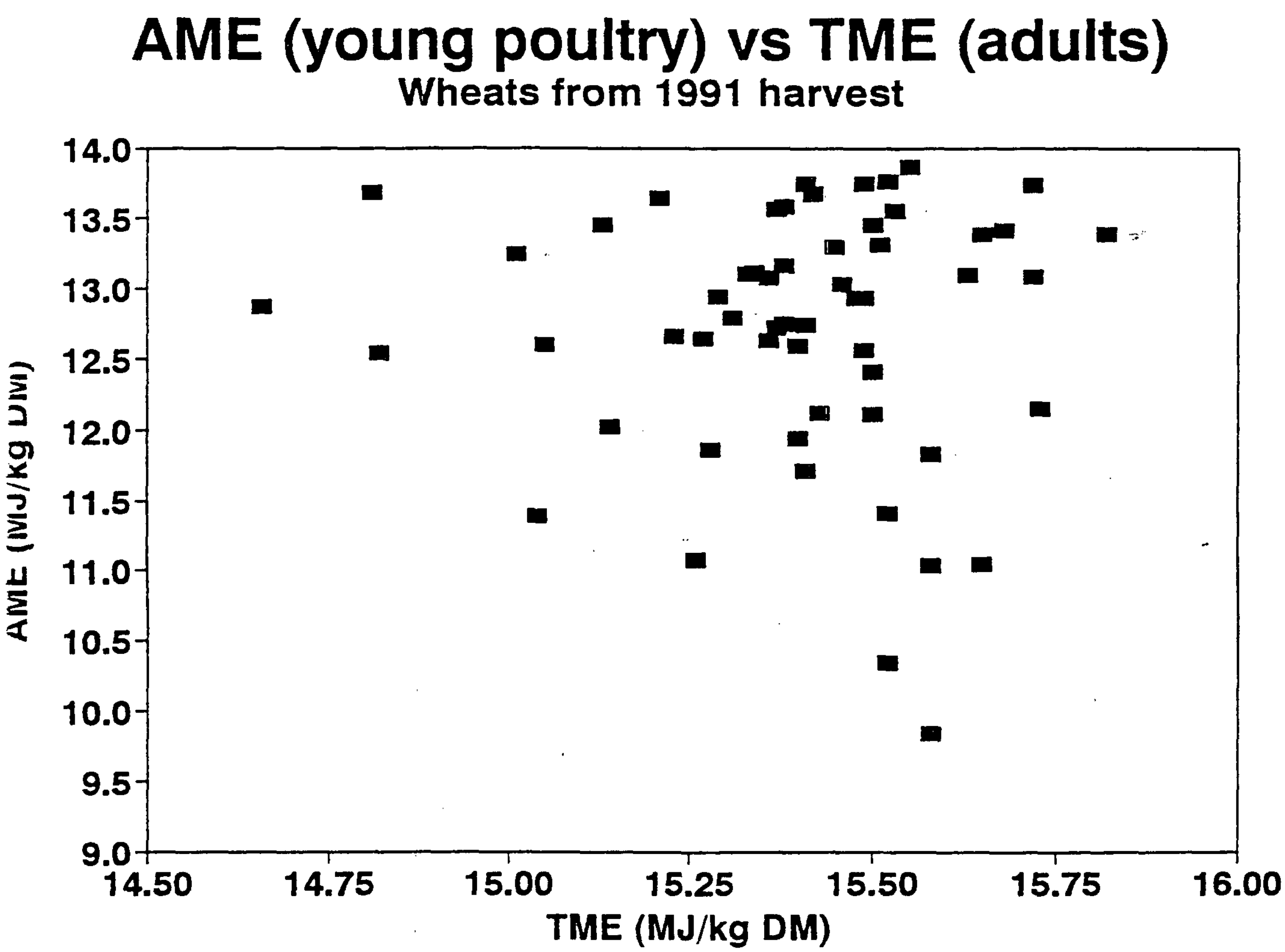
AME of all Wheats (MJ/kg DM)

Evaluated with Young Poultry



Figures over each column refer to number of determinations for each variety

FIGURE 3.



AME (young poultry) vs TME (adults)
Wheats from 1991 harvest
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
AME (MJ/kg DM)
14.50
14.75
15.00
15.25
15.50
15.75
16.00
TME (MJ/kg DM)

FIGURE 4.

See figure 1 for varieties

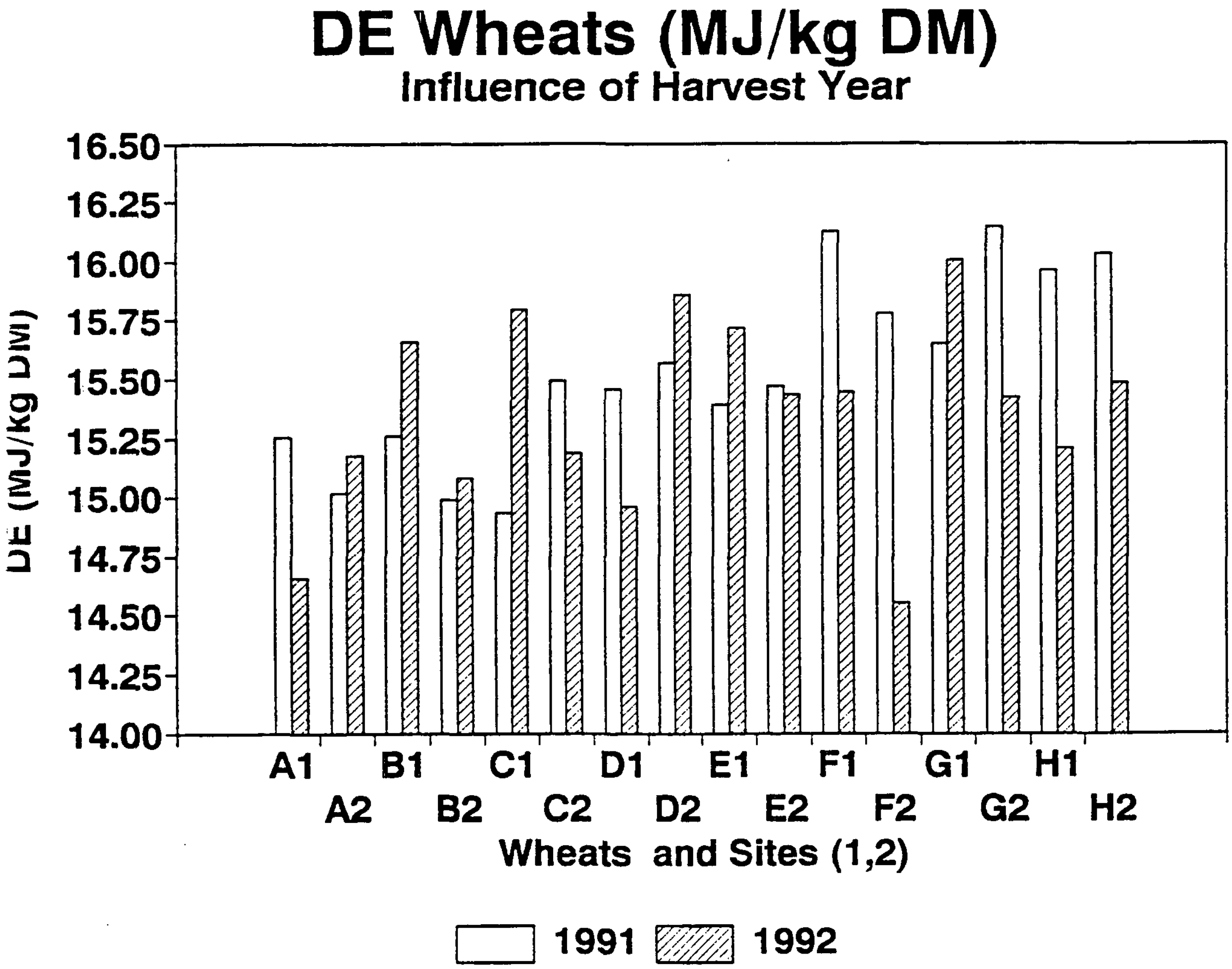
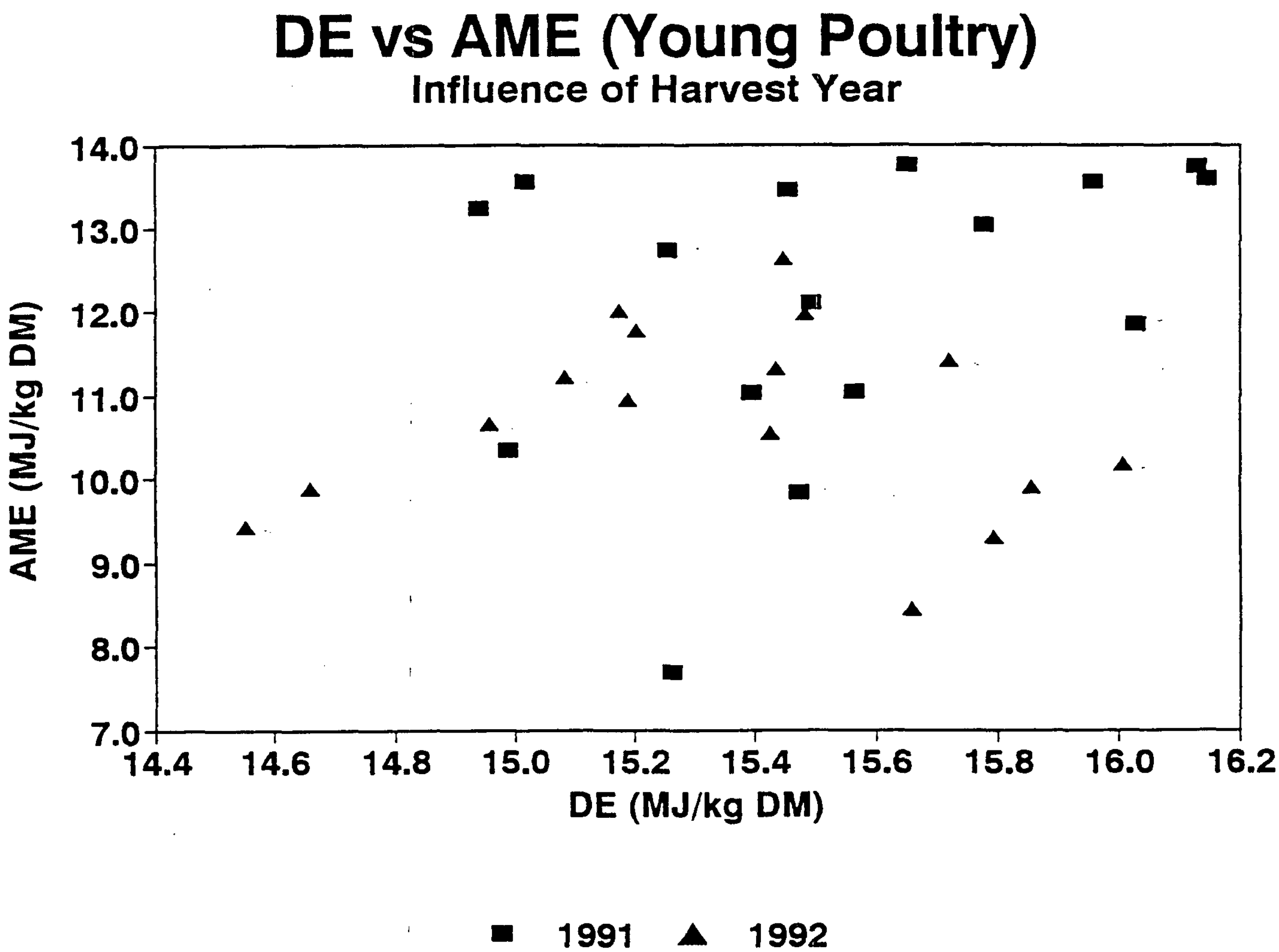
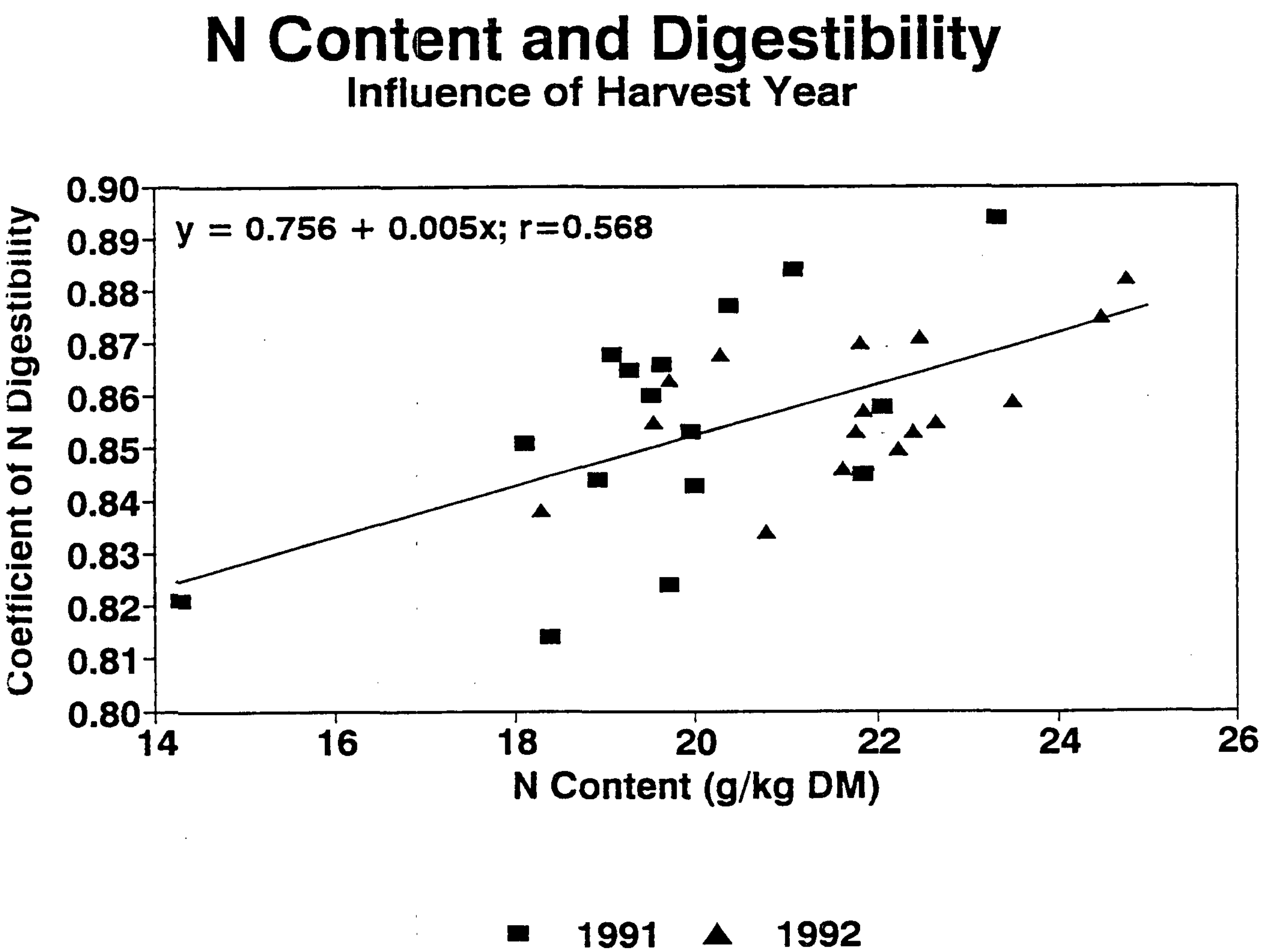


FIGURE 5.



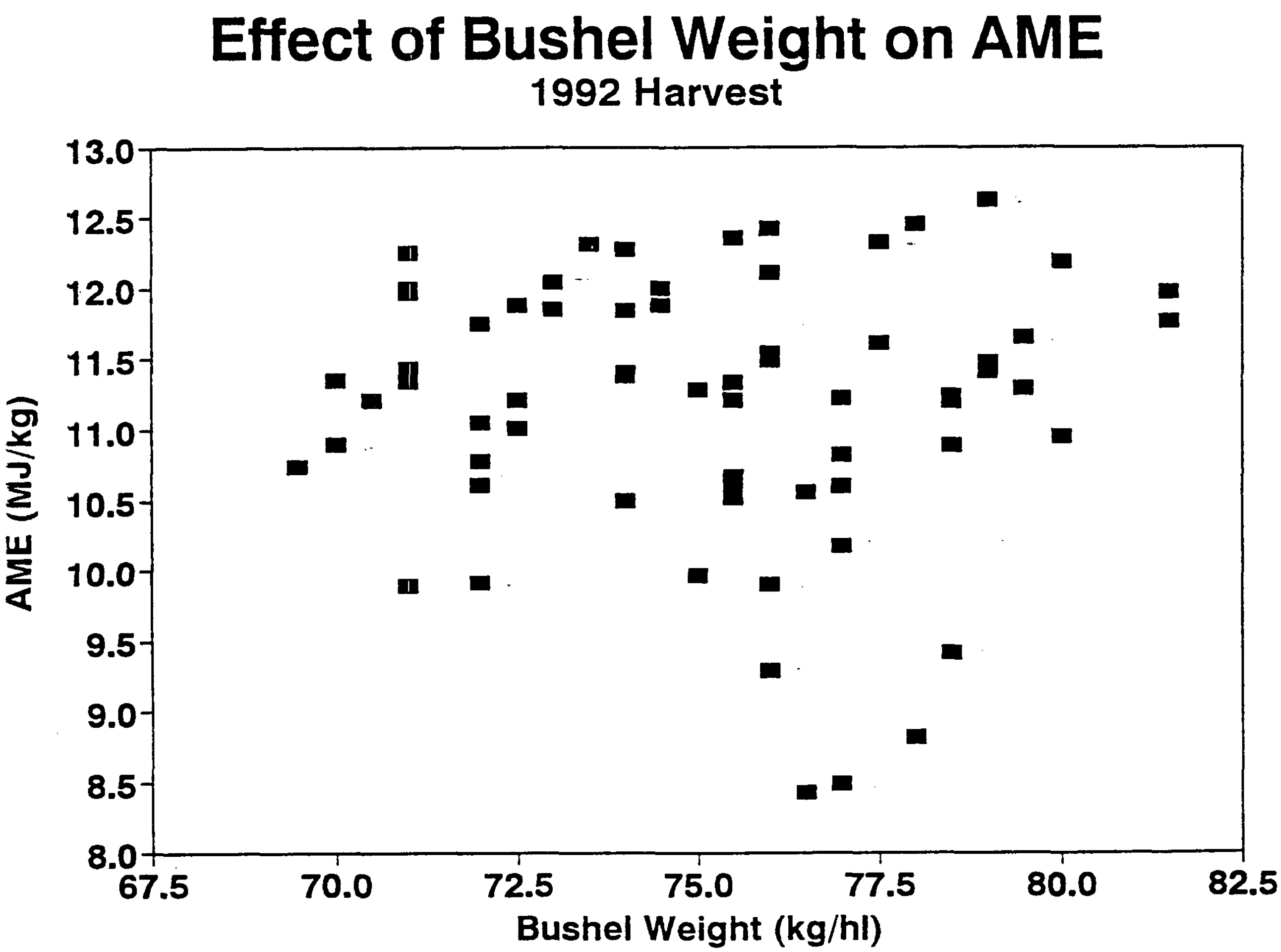
DE vs AME (Young Poultry)
Influence of Harvest Year
AME (MJ/kg DM)
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
14.4
14.6
14.8
15.0
15.2
15.4
15.6
15.8
16.0
16.2
DE (MJ/kg DM)
1991
1992

FIGURE 6.



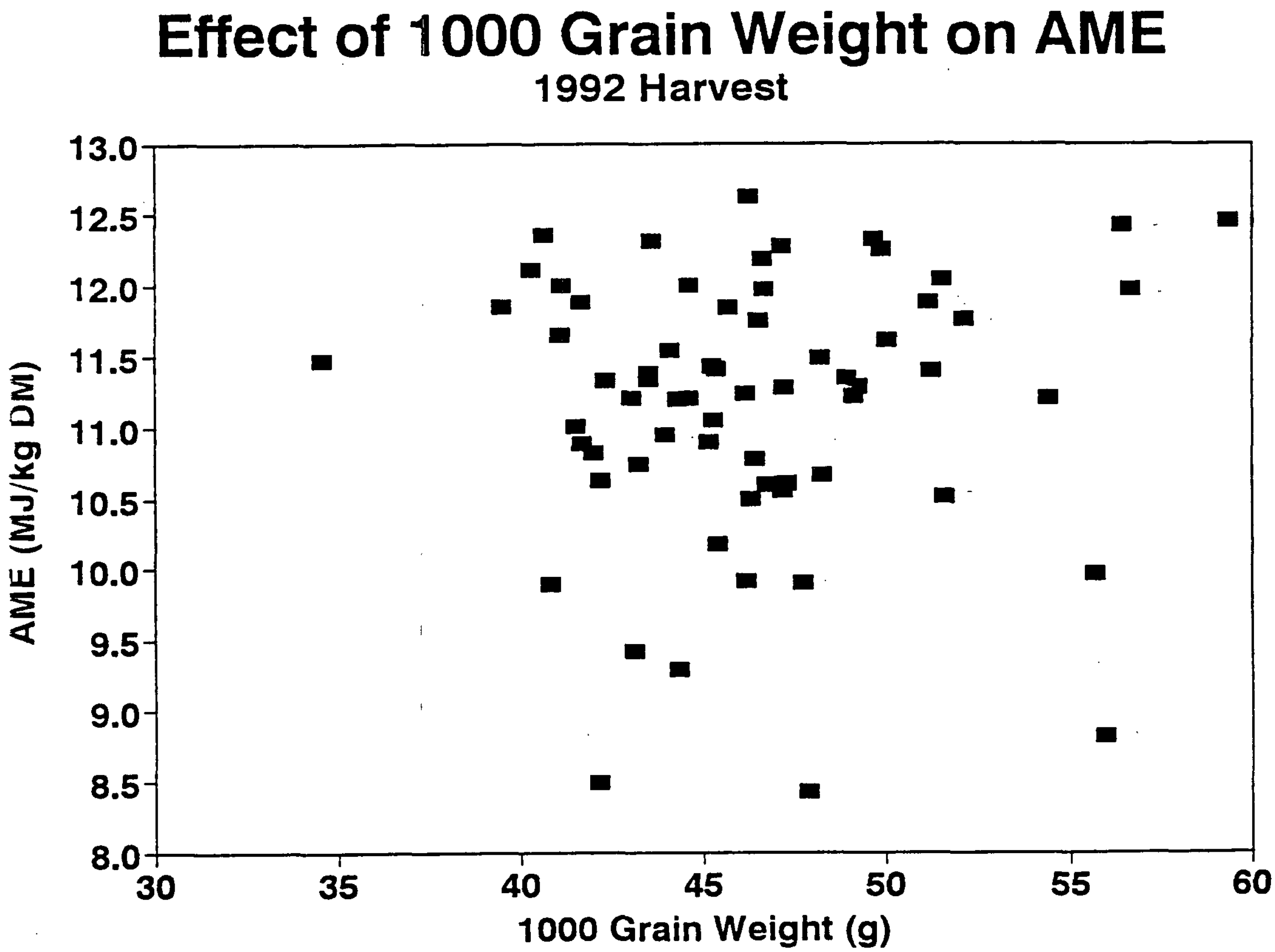
N Content and Digestibility
Influence of Harvest Year
y = 0.756 + 0.005x; r=0.568
Coefficient of N Digestibility
0.90
0.89
0.88
0.87
0.86
0.85
0.84
0.83
0.82
0.81
0.80
14
16
18
20
22
24
26
N Content (g/kg DM)
1991
1992

FIGURE 7.



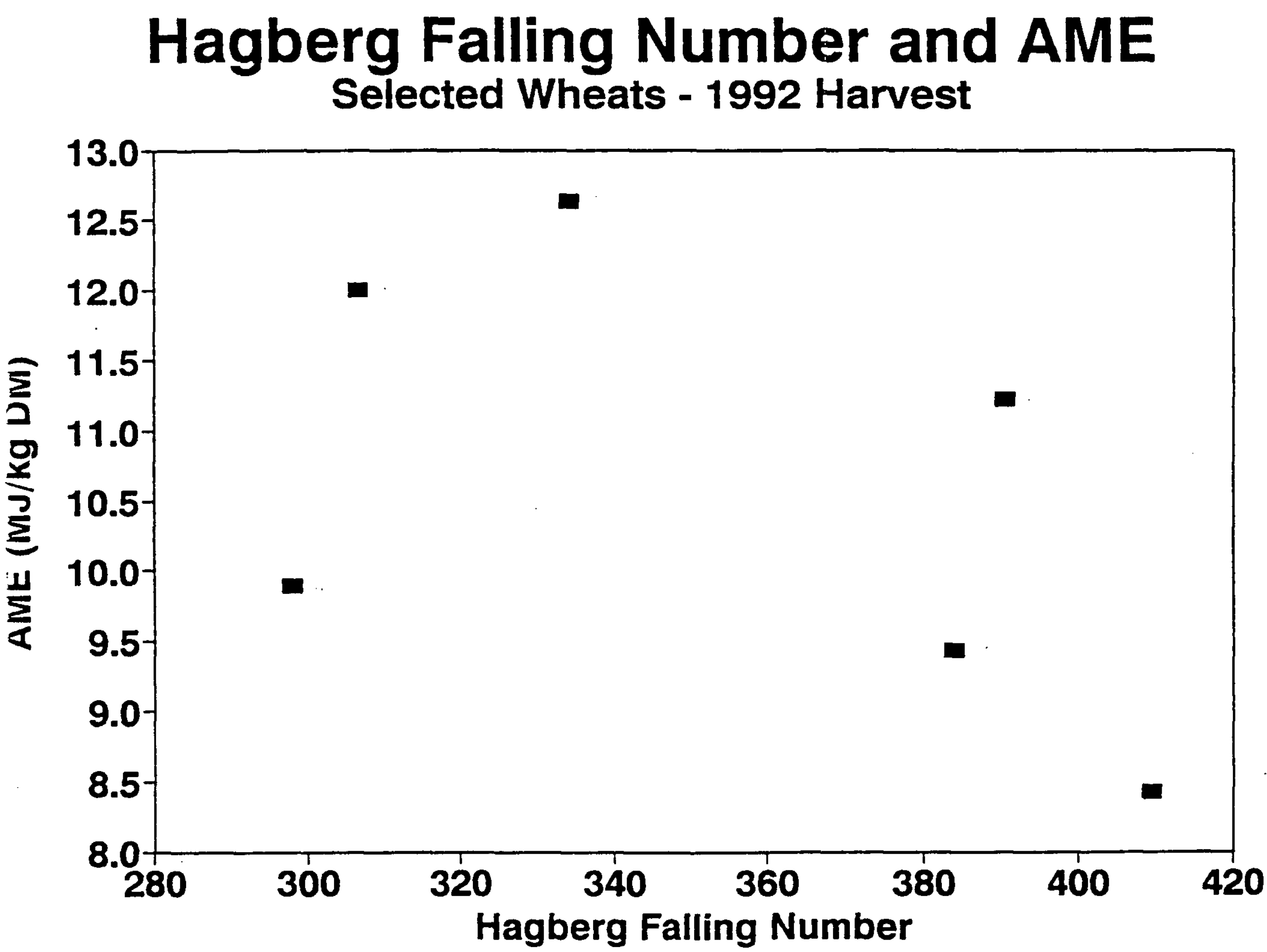
Effect of Bushel Weight on AME
1992 Harvest
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
67.5
70.0
72.5
75.0
77.5
80.0
82.5
AME (MJ/kg)
Bushel Weight (kg/hl)

FIGURE 8.



Effect of 1000 Grain Weight on AME
1992 Harvest
AME (MJ/kg DM)
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
30
35
40
45
50
55
60
1000 Grain Weight (g)

FIGURE 9.



Hagberg Falling Number and AME
Selected Wheats - 1992 Harvest
AME (MJ/kg DM)
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
280
300
320
340
360
380
400
420
Hagberg Falling Number