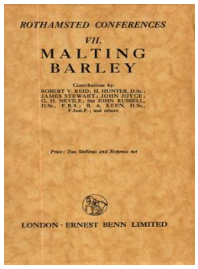
ROTHAMSTED RESEARCH

Malting Barley

Full Table of Content



Malting Barley : Old and New Varieties

H. Hunter

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their maltings there is no possible chance of any inferior barley escaping their notice.

(11) In the event of a farmer having more than one field of barley, it is advisable to keep the barley from each field separate, and to sell it on individual samples. It is possible that all the fields were originally sown with the same seed, but it cannot be taken for granted that each field when harvested will be equal in quality.

(12) Established confidence and a reputation for good deliveries will always secure a preference and the top market-price.

It would appear that of recent years our research work, combined with practical experiments and practical working, has established the importance of the nitrogen-content in the barley as a test of satisfactory malting quality, and much information and assistance is, and will become, available to the barley grower as the work proceeds.

I need not in this paper give you tables to prove the more satisfactory malting results from barleys with low nitrogen-content, these are available in the published analytical reports of the Institute of Brewing Research Work, and very interesting records are given by Lancaster in a paper read by him to the N.I.A.B., and published in that Institute's journal in 1926. In this paper Lancaster dealt with the subject exhaustively, and so fully covered the ground generally as to quality in malting barley that I would commend a study of it to those who would desire to take the important subject of my paper further than I am able to do to-day, for I am sure I have taken my full share of your valuable time, and, having been requested to talk to you on this subject, I have judged that it would not be in the real interest of the growers, the scientific research workers, the maltsters and the brewers if, in this period of transience from darkness to light, I were to dogmatize more particularly than I have done on "what the barley buyers want."

MALTING BARLEY: OLD AND NEW VARIETIES

By H. HUNTER, D.Sc.

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Varieties of cereals furnish suitable material for research on many lines, for they reflect the character of agricultural and consequently of human evolution in no uncertain manner. The diversity of form and adaptability to environment they display are matters of considerable interest to the botanist and evolutionist alike, but this meeting is mainly concerned with their economic side, and perhaps more particularly with varieties as we know and use them to-day.

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I might present the subject of malting barleys to you merely as a record of varieties, but it may be more useful if I treat them as stepping-stones in a line of progress.

Although there are many references to barley in old agricultural works, the comparative value of varieties on a quality basis does not appear to be of serious moment until within comparatively recent times. To-day the variety question is a many-sided one. There are two large interests involved—that of the producer, the farmer, and that of the maltster and brewer—and our concern as plant breeders and agriculturists is to endeavour to harmonize these interests.

The farmer's interest does not differ in essentials from that of other business, it is merely a remunerative financial return per unit area. This may be achieved by a high yield per acre, or by lower yield combined with a higher quality sufficiently remunerated to compensate for lower yield. Whether the latter course is practicable depends on a number of circumstances, but what is certain is that for the generality of conditions a combination of high yield and high malting quality is the goal to aim at. I shall endeavour to show later that these two attributes of what we may regard as an ideal variety are not antagonistic and can be obtained in combination.

With a general increase in soil fertility, proceeding from the introduction and use of artificial manures and a greatly increased cost of production, it has become essential to pay greater regard to the character of the straw of all our cereals, and more particularly that of barley. This is a pressing agricultural aspect of the variety question.

A good variety of barley should also possess a wide range of adaptability to soil and climatic conditions, for a line of general policy with this cereal should be a strict limitation of the number of varieties in use. In no other manner can we hope to obtain that uniformity of character and freedom of mixture of different sorts that the maltster and farmer desire. The brewers' requirements have been dealt with already. Whilst in the main they involve a high starch or, inversely, a low total nitrogen-content in the grain, there appears to be some difference in less readily defined qualities in the requirements of different breweries. It is hoped that the malting and other investigations now being carried out by the Institute of Brewing will eventually supplement our knowledge on the values of home-grown malting barleys. At the moment they are perhaps not sufficiently advanced to use in other than a tentative manner. Most of the information I shall present on this aspect of the question is derived, therefore, in so far at least as older varieties are concerned, from a series of experiments made in Denmark by the Royal Agricultural Society of that country in collaboration with the Carlsberg Brewery, Copenhagen, and from a similar series carried out in Ireland by the Department of Agriculture there in collaboration with Messrs A. Guinness, Son & Co., Ltd. To what extent these results are applicable to conditions in this country

https://doi.org/10.23637/ERADOC-1-200

remains to be seen, but the fact that the variety finally decided upon for use in Ireland, where it is now grown on 90 per cent. of the barley area, has already attained a high position of merit in this country indicates a strong possibility of a close correspondence in the final position.

Cultivated even to-day, in isolated patches, there are to be found a number of narrow-eared barleys under the names of Scotch Common, Old Irish, Old Cornish, Early Welsh, Nottingham Long Ear and Old Wiltshire Archer. These conform tolerably well with the three sorts, "Rath-ripe," "Middle Ripe" and "Late Ripe"—barleys that Lisle states in his *Observations on Husbandry*, 1757, were in general cultivation in the eighteenth century. The tenacity with which the cultivation of some of them is still persisted in indicates the possession of special features of adaptation to definite conditions of environment. Old Irish, for instance, is still grown in parts of Co. Wexford. It is early-ripening, and this feature is probably the reason for its use on the heavier soils of that county, for in no other respect is it a desirable variety. Such tests as have been made with these varieties indicate that they are inferior in both yield and quality to more recent introductions. They are also, as a rule, weak-strawed.

Just a little over a hundred years ago a narrow-eared barley, named after its propagator, Dr Chevallier, made its appearance. We have no knowledge of its ultimate origin beyond what has been published by Dr Beaven. In course of time various selections of Chevallier—such as Webb's Kinver Chevallier, Hallett's Pedigree, etc.—appeared, but they all resemble one another closely, and all arose, most probably, from the original barley picked out by Dr Chevallier.

Chevallier marked a very definite advance on the narrow-eared varieties in use prior to its introduction, from which time until about twenty years ago it was grown extensively in the British Isles and on the Continent. In the appearance of the grain, in quality and in yield, it was much superior to the other narrow-eared sorts I have just mentioned. As brewing material, Chevallier long held deserved favour with the brewers. Its eclipse was brought about by Archer, to which barley it was found inferior in yield, in strength of straw and, finally, with accumulating knowledge, in malting quality.

The origin of Archer is obscure; until recent years it was grown in an unselected condition in the East and South-East of England, where it is believed to have existed for a long time. It bears a strong likeness to Lisle's "Late Ripe" barley, and it is considered by some authorities to be the present-day representative of that sort. The record of Archer during the past twenty years marks it as a variety of outstanding merit. Agriculturally, it possesses several most desirable features—high grain productivity, short straw, standing well under many conditions; short neck, no loss of ears becoming detached from the straw, either before or during harvesting. Archer can thus be left standing until it is

https://doi.org/10.23637/ERADOC-1-200

completely ripe, and is the easiest of all varieties to thresh. The grain, however, does not possess the attractive colour or general appearance of Chevallier.

In Denmark, and later in Ireland, Archer enjoyed unqualified success, being proved superior in yield to Chevallier and all other varieties against which it was tested. Furthermore, except in districts where it was too late in ripening, Archer exhibited a wide range of adaptability, and some evidence of a higher relative potentiality on less fertile soils.

These facts enabled it to be used as a standard of comparison for other varieties, and many of us have acquired the habit of considering both old and new varieties on this basis.

For a time the valuation of samples in Denmark was based on the physical appearance of the grain, points being allocated to form, colour and quality. On this basis, Archer—or Prentice, as the barley was known in Denmark—mainly on account of the duller colour of the grain, actually occupied an inferior position. *In the brewery, however, the total nitrogen-content of Archer was found to be lower than that of all other varieties, excepting Goldthorpe, and this corresponded with a higher quantity of extract on malting.* The Irish trials confirmed those obtained in Denmark on this point.

Proceeding from the results of this work, a good many pure-line selections were made from the Archer barley, which previously existed as an unselected population. To the selection and distribution of these pure lines the increased average yield of barley in Denmark from 1890, and in Ireland from 1900, may be mainly attributed.

Coming now to broad-eared barleys, the only older form meriting attention here is Spratt. Spratt barley in early growth is characterized by a long, narrow leaf and abundant tillering, features to which it probably owes its name—for Sprat, Sprit or Sprot are Scotch words used for any coarse kind of reedy grass growing on marshy ground. From references found in Fitzherbert's *Boke of Husbandrie*, 1523, we gather that Spratt barley is an old-established form. It is still grown to a small extent in the Fens, where it yields large crops of grain—not, however, of the best malting quality. A striking feature of Spratt is its strong, upright straw. On this account it has been utilized as a parent in certain new hybrid barleys, and this is its chief claim to notice here.

The next broad-eared variety is Goldthorpe, which was found in a field of Chevallier so recently as 1889. How it arose, or whether it has any connexion with the Continental broad-eared forms, I cannot say.

Goldthorpe has a high grain-yielding potentiality, but it is characterized by a long "neck," and the ears are extremely liable to become detached from the straw, especially when the crop is allowed to become fully ripe, as it should be, to obtain the highest quality. The unfortunate bearing of this characteristic on the fortune of the variety will be appreciated when I add that Goldthorpe was, and still is, one of the best

https://doi.org/10.23637/ERADOC-1-200

quality barleys in existence. In both Denmark and Ireland it proved excellent malting material, and invariably superior to Archer by a small amount.

In yield of grain Goldthorpe is usually inferior to Archer, but the degree of inferiority varies with the incidence of loss, due to causes just indicated.

In common with many other broad-eared barleys, Goldthorpe is better suited to the richer and heavier soils than to those of a lighter, gravelly nature, on which narrow-eared barleys flourish. It also requires plenty of moisture to produce the best yields and quality: as it ripens from a week to ten days earlier than Archer its cultivation is possible well into the North of England and the Lowlands of Scotland.

In the light of the Danish and Irish experiments, and, to a large extent, in that of general experience in this country, the position reached at this point may be summarized briefly as follows: on the generality of soils, and almost independently of season, Archer is the most remunerative variety for the farmers to cultivate. Goldthorpe exhibits a greater susceptibility to the effect of soil and season. In most seasons Goldthorpe produces grain of slightly higher malting quality than Archer, but in general this difference is insufficient to permit of a difference in price sufficient to compensate for deficiency in yield.

These findings, of course, postulate a close adherence to quality, as determined by the total nitrogen figures and by the actual quantity of extract obtained on malting. They may not allow sufficiently for difference in physical appearance and colour, and they certainly do take into consideration the *appearance* of the malt, which is, I gather, not an extremely important factor in malt valuation. But this is an issue quite outside my province, and, as it is still a matter of experience, evidently one difficult to define, although its importance is unquestionable.

So far we have concerned ourselves with what may be called natural varieties, but, with the development of the study of heredity, as related to both plants and animals, the last twenty-five years has witnessed extraordinary efforts to synthesize agricultural plants, amongst other things. As a result, interest in the barley crop is now focussed on a series of new varieties, which represent efforts to reconcile still more closely the interests of the farmer and the brewer, or, in other words, to combine higher grain-yield and reduced risk and cost of harvesting with higher malting quality.

One of the first hybrid barleys to be placed on the market was Standwell, which was introduced by Messrs Garton. Standwell is characterized by a large and whitish-coloured grain. In the Danish and Irish experiments it proved inferior to Archer in both yield and quality. Two features, brittleness of straw and a high degree of "blindness," militate against high yield in this variety. To secure the crop against loss through ears breaking off the straw it is necessary to cut it before it is

https://doi.org/10.23637/ERADOC-1-200

fully ripe—a procedure which must inevitably react detrimentally on the quality of grain.

Standwell is early-ripening and proves valuable on heavy soils and in late-ripening districts.

Other varieties—such as Maltster, Brewers' Favourite, Invincible, all very similar to Standwell—appeared later, but have now disappeared almost completely from cultivation.

The next hybrid variety to claim attention is Plumage-Archer, which was produced by Dr Beaven in 1905. Plumage is a broad-eared barley, closely resembling Goldthorpe in all features, and the Archer used in the cross was a pure line selected by Dr Beaven. Recognizing the high quality and yield of Plumage, and the high yield and almost equally good quality of Archer, Dr Beaven set out to attempt to produce a broad-eared barley with the shorter neck and, consequently, the immunity to loss of ears found in Archer, and the variety we know to-day as Plumage-Archer is the result. The manner of selecting this particular form, and of later forms—such as Beaven's 1924—has been described by the producer.

In yield of grain and in malting quality Plumage-Archer is outstandingly good, and furnishes an example of successful synthetic effort, and is a tribute to the long and enthusiastic work of its producer.

Like most broad-eared varieties, Plumage-Archer shows a preference for the rather heavier soils. It is relatively early-ripening.

Archer-Goldthorpe (451) is another broad-eared variety, and is the result of an attempt to improve Goldthorpe by reducing the length of "neck." In length of straw and of neck this hybrid resembles the parent Archer. Unfortunately the yield is not equal to Archer, but the quality of grain is invariably good, and probably slightly superior to the Plumage-Archer standard. The variety is early-ripening, and this feature, combined with a short, stiff straw, indicates the possibility of successful use on heavier soils and in late districts. Following, we come to Spratt-Archer, which had its origin in the following circumstances. Although Archer proved so successful in Ireland, it exhibited two features which came to be regarded as undesirable. In seasons characterized by abundant and rapid vegetative development in the spring the straw was inclined to be weak, and thus liable to "lodge." Again, in wet seasons and in seasons of deficient sunshine—conditions perhaps more generally prevalent in Ireland than here—it was late in ripening.

For several reasons it was considered desirable to adhere to the use of a narrow-eared variety in Ireland, and for a time the forms of this type—secured from a cross with Goldthorpe—were studied, but none was sufficiently promising to justify extended cultivation.

Of all native varieties Spratt possesses the greatest strength of straw, and, although the malting quality of the variety is below the average, it was decided to try it as a parent. From this cross a narrow-eared form

https://doi.org/10.23637/ERADOC-1-200

was finally selected, and from its produce a series of further selections made, of which No. 6 is the one now in general use.

The average yield of grain per square-yard plot, in 1918 and 1919, of Archer and Spratt-Archer, was :

	1918 *17 comparisons*	1919 *35 comparisons*
Archer . . .	211 grammes	185 grammes
Spratt-Archer, 37s. 6d.	225 ,,	233 ,,
	14±7	48±5

whilst the total nitrogen figures for the same plots were :

	1918	1919
Archer	1·73 per cent.	1·46 per cent.
Spratt-Archer, 37s. 6d. .	1·53 ,,	1·27 ,,
	0·20±·012	0·19±·013

Subsequently these results were corroborated by those of field tests carried on in several counties. At the same time the greater strength of straw and earlier-ripening habit of the hybrid was definitely established. In the malting tests Spratt-Archer proved superior to Archer, as the nitrogen figures would lead one to suspect, and thus Archer loses its position of superiority in the same way and for the same reasons that Chevallier did.

The effect of the slightly earlier ripening habit was reflected in the qualitative and quantitative result in the following way. In late-ripening seasons Spratt-Archer was unquestionably superior to Archer in yield and quality, whilst in early-ripening seasons, such as 1921, ripening was greatly accentuated, and the difference between the hybrid and the naturally later Archer, although in the same direction, was not so marked. But it will be remembered that 1921 was an abnormally dry, hot year, and represents a condition not repeated very frequently.

A word as to the economic effect of the introduction of Plumage-Archer and Spratt-Archer, which, for purposes of comparison, we may regard as identical in yield. Turning to the Irish yield figures we find that the substitution of pure-line Archer for Chevallier, as grown in the country in, say, 1900, may be claimed to account for an improvement of yield amounting to 7 bushels per acre, and that of Spratt-Archer for pure Archer, 4 bushels per acre, or a total improvement of 11 bushels per statute acre. Again, as both Plumage-Archer and Spratt-Archer are superior to Archer in malting quality, we may safely and fairly assume that the maltster and brewer have benefited in this direction.

Viewing Plumage-Archer and Spratt-Archer as hybrid varieties it is noteworthy that both exhibit high yield, combined with high malting quality. Exactly which attributes of yield are accentuated in these

https://doi.org/10.23637/ERADOC-1-200 pp 8

varieties it is not easy to say, but that they represent a closer approximation of the requirements of the two large interests involved than obtained twenty years ago is unquestionable. Plant-breeding is essentially the progressive accumulation of small improvements, and from that point of view the new barleys offer a jumping-off point for further effort along the same lines as I have endeavoured to indicate. The variety tests carried out by the National Institute of Agricultural Botany, in co!-laboration with the Institute of Brewing, during the two years 1925-1927, included Plumage-Archer, Spratt-Archer and Archer, together with three barleys appearing under numbers, and Sunrise—which is a selected Archer put on the market by Messrs Webb & Sons.

The numbered varieties No. 824 and No. 825 are narrow-eared selections from a cross between Russian Goldthorpe and Archer, made by Mr Engledow, at Cambridge, whilst No. 25 is a selection out of Plumage-Archer.

A brief survey of the results obtained during the period is appropriate here, for it brings what I have previously said up to date, and probably with greater appeal, as the tests were carried out in this country.

The figures of average yield for the three-year period show that Spratt-Archer is the most prolific variety, and this result is common to all the experimental stations. Archer-Sunrise, No. 25, and Archer-Goldthorpe were inferior to the standard Plumage-Archer. The two barleys Nos. 824 and 825 were included in two of the three years only, and it is difficult, consequently, to say exactly where they stand, but, taking the figures for the two years in which they were tested, they are superior to the standard by approximately the same amount as Spratt-Archer.

Combining the figures of yield and those of value derived from valuations and analyses made by the Institute of Brewing Valuation Committee, Plumage-Archer shows the highest value per acre. It is followed in order of merit by Spratt-Archer, and then by Nos. 824 and 825, No. 25, Archer-Goldthorpe and Sunrise.

Thus the final position is very similar to that I described above. As between the best barleys there is really very little to choose. There are indications of the partiality of some varieties for certain soils, and probably the operation of this condition accounts for many individual differences. By following up this aspect of variety work it may be possible to render the barley industry further assistance.

Whilst the determination of the relative values of varieties is a fundamental step in all attempts at crop improvement, it is by no means the whole story, and to translate this story into actual practice is not quite so simple as it appears.

Something between 60 and 70 per cent. of the seed used in this country is grown by the farmer himself or sold from farmer to farmer, and yet there are no steps taken to ensure either its purity or its trueness

https://doi.org/10.23637/ERADOC-1-200

of name ; nor, so far as I am aware, have any effective steps been taken to organize an efficient seed-supply on a sufficiently large scale to influence the character of the crop by areas. I therefore submit this side of barley growing for the special consideration of maltsters and brewers. The regulation of a proper seed-supply has been the corollary of variety investigations in other countries, and it is no less necessary here than elsewhere.

INFLUENCE OF SEASON ON QUALITY AND YIELD OF BARLEY

By JAMES STEWART

In approaching this subject, I intend to take as my basis the conditions appertaining to the principal malting barley-growing counties as a whole. Therefore my findings can be taken to apply to the average results obtained in any one season.

Yield.—So many factors influence the yield that one cannot altogether go on the published statistics. It is quite evident that, given droughty conditions, the yield must suffer, and if the reverse be the case the yield is greater. In the latter case the yield suffers materially if the weather conditions are abnormally wet and cold ; for example, in the English barley crop of 1927, when weather conditions were without parallel since 1879, the average yield was 16·4 cwt., or 2 cwt. per acre *more* than the average of the last ten years.

Scotland, however, experienced normal conditions up to the beginning of August, but in August and September the rainfall was 14·93 inches against 5 inches normal, and this materially affected the yield, as the following figures show :

The average bushel weight of malting barley in Scotland in 1927 was only 51¾ lb. In 1925, which was a good summer, the average weight was 55 lb.

From a study of the yields in England and Scotland since 1920 the facts emerge :

(1) The yield is greater in a wet season.
(2) It is practically an average in a normal season.
(3) It is much less in a dry season, and also in an abnormally wet season.

The yields in Scotland are invariably greater than they are in England, and it will be generally acknowledged that there is more rain, less sun, and lower temperature in Scotland than in England ; but of course it must also be remembered that Scotch barleys invariably contain a much larger percentage of moisture.

https://doi.org/10.23637/ERADOC-1-200 pp 10