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History of Winter Beans (*Vicia faba*) in the UK

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Summary

Winter beans remain popular in England, although the hardy *equina* types have a rather short history. The type introduced to the UK in 1825 and grown until the early 20th century was winter hardy and early maturing but small seeded (about 350g/1000 seeds). It is believed that out of a total of over 200,000 ha grown at the end of the 19th century, a high proportion of the beans grown on the clay soils of southern England were of this winter type. The change from these hardy *minor* to hardy *equina* types took place about 1920 - 1945, but details of breeding that effected this change are unknown. Since World War II breeding has concentrated on composite varieties with improved yields, strong straw and disease resistance.

Introduction

Recent dry springs and summers in the UK have had an adverse effect on the yield of spring beans resulting in an increasing proportion of winter beans (67,000 ha of winter and 31,500 ha of spring (MAFF 1998); 68% and 32% in 1997). This contrasts with a decreasing area of winter beans in France, the only other north European country with a tradition of winter bean cultivation. Winter beans are less hardy than winter wheat but nearly as hardy as winter oats. Current recommendations are not to sow winter beans in Scotland or the north of England (Knott 1997, PGRO 1994), as, apart from winter damage, late maturity is an undesirable factor. Winter beans do not need to be vernalised in order to flower but unvernalsed plants flower on a higher node.

In England, winter beans have been a well established crop for over a century and a half. Varieties here have reached a state of good adaptation to the climate, and husbandry has improved to allow enough control of biotic stresses. Before reaching this stage however some substantial changes had taken place, though not all thoroughly recorded. We have tried to present a record of what we believe happened in the history of winter beans in the UK during the last 175 years, together with some comments on current varieties. The latter relate mainly to England because very few winter beans are grown in Scotland, Wales and Northern Ireland at the present time.

Before 19th Century

Tusser (1573) wrote that sowing beans was one of the tasks for November (as well as for February and March), but it was, according to Tusser, a job for the garden as well as for the field, and the omission of October for sowing is significant suggesting that these beans were not true winter hardy types. Young (1804) and Loudon (1825) gave detailed descriptions of how beans were grown at the end of the 18th century but none refers to autumn sowing.

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19th Century

It is likely that true winter hardy beans were not cultivated in the UK until the nineteenth century. Porter (1925) stated that the 'Little Winter' or 'Russian' bean was introduced to the UK in 1825. This was the main winter bean grown in the UK, until the 20th century. It was small seeded (*V. faba* var. *minor* about 350g per 1000 seeds). Greenwood (1956) concluded that English winter beans have a short history because of their introduction in 1825. The descriptions given by Haxton (1855) and Percival (1908) are similar to the French population Cote d'Or suggesting that the small Russian winter bean may have been cultivated in eastern France at the same time as, or before, being imported to the UK. They describe them as small-seeded (less than 370g/1000 seeds), and "the plant grows 3 or 4 ft" (1.3m). The description of *Féverole d'hiver* given by Wilson (1847) is very similar to that of the Little English or Russian winter bean (*V. faba minor*) described by several UK authors during the 19th century. Thus, the height was nearer to that of Cote d'Or than present-day winter beans which often reach 1.7 or 2.0m. This suggests that the Little English winter bean may have come from France. However the name 'Russian' suggests it was imported from the east for animal feed and found to be hardy when grown here. Muratova (1931) wrote that field beans (*Vicia faba*) were much in demand for export from Russia to England and other Western countries at the end of the 19th century.

The French type was designated by Lechner (1959) as *V. faba subaigerima* KCKE, (1000 seed weight 290-320g), and was cultivated mainly in the South of France. All Wilson's (1847) recommendations on cultivation of field beans were in respect of spring beans, indicating that winter field beans probably only gradually became cultivated in UK during the 19th century. However, Stephens (1871) clearly favoured winter beans.

Field beans were an important crop at the end of the 19th century; they were second only in area, to winter wheat. About 224,000 ha of field beans were grown in the UK in 1873 (Knott, 1997) at least half of which were probably winter beans. This seems a large area to put at risk of frost damage if the old English winter bean was doubtful in terms of hardiness. This is borne out by Wrightson and Wright (1908) who, when referring to the small-seeded *minor* (Russian) type of winter bean, wrote "The winter bean is a favourite in Scotland as well as England". This suggests that the current restriction and recommendation for cultivation of winter beans only to south of the Humber may have arisen only when the Russian winter bean was no longer available. It was probably found that the modern *equina* type of winter beans were too tall and late-maturing for Scotland and the North of England, not that they were less hardy. Certainly Greenwood (1955) commented that winter beans were limited to the southern half of Britain.

Spring beans in the North of England in late autumn during 1950-1985 (and probably also in the 19th century) were often not ready to harvest until November or December. (Rivett, personal communication). Thus, in the 19th century growers may well have preferred the short early maturing winter beans (Russian type) in Scotland and the North of England. The value of the earliness of flowering of winter beans was also appreciated by Stephens (1971) who wrote that they escaped the 'black dolphin' (*Aphis fabae*) a pest which destroyed a large proportion of spring beans in England in 1847. Maturity date was probably a more important factor.

Estimated yields of field beans made by MAFF (Ministry of Agriculture, Fisheries and Food) (1867 to 1920) did not show any special drops in yield associated with a

severe winter, except perhaps in 1917.

First Half of the 20th Century

Porter (1925) and Percival (1935) both described English winter-bean seeds as "resembling tick beans". If these authors reflect agricultural practice at the time then the change from var. *minor* to var. *equina* types must have taken place sometime in the period 1920 - 1945. By 1949 spring tick beans were described as smaller and rounder than the common winter sorts (Watson and More 1949). Certainly, the winter varieties surveyed by Greenwood (1959) from a NIAB (National Institute of Agricultural Botany) collection begun in 1948, were all *equina* types.

However the era of the *minor* type winter beans was still within living memory in 1948 when farmers and merchants in East Anglia were blaming the crop losses due to frost in 1940 and 1947 on the then non-availability of the Russian or Old Little English winter bean (Bond 1985). This was at a time when the country was short of protein and could ill afford to lose crops of beans. Even in 1952, Dunns Farm Seeds Ltd, Salisbury, were offering for sale a strain which had been selected from the old English winter bean, presumably the small-seeded 'Russian' bean. However its seeds were mixed in size and no difference in hardiness could be detected between it and 22 other UK winter beans which were tested in 1953 (Bond 1953).

It is a matter of speculation as to how the change from *minor* to *equina* types of winter bean came about between 1920 and 1945. Contemporary accounts of breeding or imports of new seed are wanting. Natural cross pollination between spring *equina* types and winter *minor* types could easily have taken place. Mixed populations could have been autumn sown, or self sown, with only hardy types surviving the winter. Cross-bred seed would have been larger and, as it is known farmers often select the larger seeds for sowing, these would therefore have tended to enter the new hardy pool. In this way *equina*-type seeds might have been selected possibly by sieving. Even after the introduction of the machine thresher towards the end of the 19th century, beans intended for sowing were still flailed by hand to reduce mechanical damage, which implies a closer inspection for seed purposes.

It is possible that some growers or merchants in the early part of the 20th century deliberately mixed the small seeded winter bean with the *equina* type English horse or Scottish horse beans in order to combine hardiness with larger seed and higher yield. It is known that a Scottish Carse spring bean, large seeded but not winter hardy, was at one time used as a component in the development of Throws M. S. (Whitton, personal communication).

Alternatively a new winter hardy variety of horse bean could have been introduced to the UK early in the 20th century. When the little English or Russian winter bean was no longer available in the UK (perhaps because of crop failure due to frost or war in the source country), English farmers would have had no choice but to use spring horse varieties for their autumn sowing. Many would rather risk frost damage than change to a spring sowing with late maturity and low yields in dry seasons. It could be significant that the change from *minor* to *equina* might have occurred between the two world wars and possible affected response to the very severe winters of 1940 and 1947. There may have been no alternative but to use *equina* types for autumn sowing whatever their level of hardiness.

If there had been mixing, deliberate or accidental, some of the characteristics of the little English winter bean would be expected to appear in the populations being

cultivated in 1950 onwards. However inbred lines isolated at PBI (Plant Breeding Institute) Cambridge from such populations (for example Cambridge University populations known in the 1950s as Nightingale, Charity etc.) did not include any with *minor* size seeds, none as small as 350g/1000 seeds as described for the Little English winter bean. This suggests winter hardy horse beans may have been introduced to England *de novo*, and leaves the question open as to the source of the winter hardiness. There was disquiet in 1942 about the possible deterioration of winter bean stocks following poor crops in 1940 and 1942. Oldershaw (1943) thought this was only due to unusual weather, although Thompson (in Oldershaw 1943) suggested that there may have been less intra pollination and therefore a loss of heterozygosity in the succeeding crop.

The Little English winter bean no longer exists (Greenwood 1959) and those samples that purported to be the Little English winter bean and seen in 1950, were mixed in size and shape and weighed much more than 350g/1000 seeds. Stocks were probably already contaminated by 1950, and selection for large seed in mixed populations had perhaps already fixed the new combination of hardiness and *equina* type seed. Thus when inbreeding started in the 1950s, with a view to forming composites, *minor* types of winter bean were no longer there to be recovered. Once the winter hardy *equina* populations had been established they quickly spread among seed merchants in England because of their greater vigour and yield.

There is an association between small-seededness and hardiness in many grain legumes. Small seeds produce small seedlings which can be better protected by snow and clods; however the twentieth century experience with *Vicia faba* is that hardiness can be transferred to *equina* types and possibly to *major* types.

Table 1: Mean seed weights of UK winter beans and some other *Vicia faba* varieties

Variety	Approx. years of cultivation in UK	1000 seed weight (grammes)
Russian or English winter bean (<i>minor</i>)	1825 - 1930	346 (Haxton 1855) 368 (Percival 1908)
Tick bean in 19th century	1850 - 1900	502 (Haxton 1855) 510 (Percival 1908)
Scottish Horse bean (<i>equina</i>)	1850 - 1950	708 (Haxton 1855) 780 (Percival 1908)
Mans Boad (tick bean) (<i>minor</i>)	1958 →	400 (NIAB)
Punch winter bean (<i>equina</i>)	1988 →	650 (NIAB)

A survey of a selection of seed catalogues of some of the nationally known seed merchants indicated that a type of winter bean not dissimilar to present '*equina*' stocks, had been marketed at least since the early 1920's. (For example, Messrs Gartons Ltd, Warrington, since 1922 and messrs Carters Ltd, Raynes park, London, since 1926). Some stocks could have been available before these dates. Although there is no evidence of the physical characteristics of these earlier seed stocks, comments in the seed catalogues indicate that they were very similar to the *equina* winter bean type that is recognised today. They are referred to as having 'larger seeds' (presumably larger than the smaller seeded spring tick bean varieties and possibly also larger than the Russian winter bean), 'tall plants', and 'more vigorous'. A photograph of a crop that

Sieving!
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had quite clearly tillered well in the manner of a winter horse bean was presented by Gartons in their 1932 catalogue, and testimonial of a crop that was "six feet high and covered in pods" (Messrs Webbs, Stourbridge, Worcestershire, 1939) would appear to confirm this. It is difficult to imagine that during the 30-year period of maintenance and production there was not some selection for characters such as winter hardiness, uniformity and yield performance in the *equina* types, even though much selection must have taken place to establish a 'winter hardy' stock in the first place. An example of the evolution of hardiness was the variety Deneb which was derived from a plant which had survived the 1947 winter. Deneb showed evidence of greater hardiness, including darker green leaves and a more prostrate habit when in official trials. Similar selection probably occurred earlier in the 20th Century.

Second Half of the 20th Century

English Varieties

As a result of concern over the relatively poor yield of the field bean crop compared to cereals, a survey of seed stocks of field beans of both UK and foreign origin was begun by the NIAB in 1948. This survey culminated in a series of full-scale yield performance trials as a result of a 5-year grant from the Royal Agricultural Society of England. During the period 1952-1964, 57 'lines', 'seed stocks' or varieties were examined, 20 of the better varieties in full scale field trials, and 37 in smaller assessment tests, (Smith & Aldrich 1967). One of the more outstanding stocks (Gartons S. Q.) was selected to be used as the control in these early trials. Gartons S. Q. averaged 26.6 cwt/acre (3.3 tonnes/ha) in 81 trials over the 13 year period. After being added to the NIAB recommended list as a control variety in 1960 it was only removed in 1968 as better performing varieties became available. Messrs Haslers & Co Ltd, Dunmow, Essex, were the first company to produce a variety based on a synthetic population aimed at maximising heterosis and avoiding inbreeding depression. Their variety "Throws M. S.", originally based on 6 and later 4 component populations, was released in 1953 (Lawes *et al* 1983). A year later (1954) a similarly bred variety, L. 12B, was the first of several varieties from the PBI, Cambridge to be released. This and subsequent PBI varieties were based on inbred components to produce a "composite" or "synthetic" population, establishing the technique as a successful breeding method for winter beans in the UK. The success of these "composites" over the original earlier "mass-selection methods" is obvious from the trial results. L. 12B was 106% of the control (Gartons S. Q.) (22 trials) and Throws M. S. 107% (64 trials). (Throws M. S. was used as one of the controls in NIAB trials until 1986). The NIAB system of variety testing led to the publication of the first farmers leaflets of field beans in 1962 followed by a seed certification scheme in 1969. This enabled farmers to have information available on the choice of varieties with a guaranteed trueness to type.

Maris Beaver, the first named variety released in 1960 by the PBI, was the fore runner of a long list of varieties right up to the present day (Table 2). Many of the improvements since 1960 have been summarised by Knott (1997). An attempt by PBI at producing an F1 hybrid using cytoplasmic male sterility was made with the cross 349 x S45 (Maris Hylas) in 1969 and subsequently other crosses. Other F1s were also made by INRA (Institut National Recherche Agronomique). All were eventually withdrawn because of reversion to fertility in the male sterile lines. Fertility restoration by the male parent was satisfactory and high yields of F1 hybrids were demonstrated (Bond 1989).

Table 2: Winter Bean Varieties in UK

Variety	Status	Country of origin	Breeder	Main period of cultivation or trial	Comments
Russian (Little English)	-	Rus	?	1825-1930	<i>Vicia faba</i> , minor, similar to Cote d'Or
Sunk Island	-	UK	Yorks Farmer	1940-1950	Farmer's Stock
Henham	L	UK	Sidd	1948-1966	Seedster's stock
McMullen	-	UK	Herts Merchant	1950-1956	Seedster's stock
Deneb	-	UK	Felhamstead	1950-1956	Winter hardy line
Gartons S. Q.	L	UK	Gartons	1950-1967	Control in first trials
Throws M. S.	F	UK	Haslers	1953-1966	First Composite, control
Cote d'Or*	-	FR	INRA	1954-1970	Small seeded, Hardy
L. 12B*	-	UK	PBI	1954	First PBI composite
Maris Beaver	F	UK	PBI	1960-1962	Population, control
Daffa	R	UK	WPBS	1966-1982	Population, better in the west
349 x S45 (M.Hylas)*	-	UK	PBI	1969	F1 Hybrid
Maris Beagle	R	UK	PBI	1973-1987	Composite, control
Bulldog	R	UK	PBI	1976-1980	Composite
Banner	R	UK	PBI	1978-1982	Composite, control
Polar (76/TW)*	NL	UK	PBI	1980-1982	First Tannin-free, 'equina' vegetable type
Taro*	CC	FR	Tourneur	1980-?	Early, Frost susceptible, S. France
Scravi*	CC	FR	INRA/PBI	1990-?	North France, composite French & English
Bourdon	R	UK	PBI	1984-1997	Composite, also in France, control
Webo*	CC	GR	Litmann	1984-1987	Winter hardy
Punch	R	UK	PBI	1986-?	Composite, Early maturing control
Hivona*	CC	GR	Litmann	1986-1992	Winter hardy
Cussar*	NL	UK	PBI	1987-1990	Inbred line, first Ascochyta resistant
Boxer	R	UK	PBI	1988-1995	Large seeded control
Glacier	F	UK	PBI	1990-1994	Tannin-free
Fabiola	CC	FR	INRA	1990-?	Very early, Frost susceptible
Bella	CC	FR	Tourneur	1991-?	Very early, Frost susceptible
Kan	CC	FR	Blondeau	1991-1992	North France type
Castel	CC	FR	Tourneur	1992-1996?	Very early, Frost susceptible
Vaccis	NL	UK	CPB	1993	
Striker	R	UK	PBI	1993-?	Ascochyta resistant
Target	R	UK	PBI	1994-?	Still straw
Clan	CC	FR	INRA	1996-?	Ascochyta susceptible
Clippor	R	UK	PBI	1996-?	Ascochyta resistant
Silver	NL	UK	PBI	1999-	Tannin free

CC = Included on the EEC Common Catalogue of Varieties.

NL = Included in the UK National List of Varieties. (All these varieties are subsequently added to the EEC Common Catalogue of Varieties).

F = Recommended by the National Institute of Agricultural Botany, Cambridge. (1950 to 1967 varieties were only 'listed' = L). All 'R' varieties are in the 'NL' category.

L = NIAB Farmers Leaflet (Before F).

* In trial but not commercialised in UK.

UK = United Kingdom
 GR = Germany
 FR = France

Blondeau = Els Blondeau, Borsée, France
 CPB = Cambridge Plant Breeders, Thriplow, Herts
 Gartons = Gartons Ltd, Warrington, Lancs
 Haslars = Haslars Ltd, Dunmow, Essex
 INRA = Institut National Recherche Agronomique, France
 Littmann = H. Littmann, Saat-zucht, Timmdorf - Malente, Germany
 McMullen = McMullen Ltd, Herts
 PBI = Plant Breeding Institute, Cambridge (up to 1987)
 PBI = Plant Breeding International (Cambridge) (1988-)
 Rothamsted = Experimental Station, Rothamsted, Harpenden, Herts
 Sadds = Sadds Ltd, Essex
 Tourneur = Tourneurs Frères, Toulouse, France
 WPBS = Welsh Plant Breeding Station, Aberystwyth, Wales

Among the composites, Bourdon was a good general-purpose variety in France as well as England, with Punch being a traditional "heavy land" variety with earlier maturity. Striker was the first NIAB Recommended variety with resistance to *Ascochyta fabae* while Target combined new levels of straw strength with earliness and very high yield. Clipper (recommended in 1998) combines high yield with stiff straw and *Ascochyta fabae* resistance. While varieties from the continent are earlier in maturity, at the time of writing none of them match these UK varieties for yield.

French Varieties in the UK

The French population Cote d'Or was tested in breeders trials in the UK in the 1960s but though very hardy was found to be weak-stawed, more susceptible to *Botrytis* and lower yielding than English varieties (by then all *equina* types). Other French varieties, e.g. Castel, Delta, Fabiola, were earlier maturing than English varieties but not as hardy and were not recommended by NIAB. Karl was similar to English varieties but was not listed in the UK. Soravi was a composite of French and English lines.

German Varieties in the UK

German varieties e.g. Webo, were tested in UK. They were very winter hardy and prostrate but not as early as French varieties. Some are thought to have originated in the Pyrenees (Littmann, personal communication) but are distinct from Cote d'Or and from *V. faba subaigerima*. None of these were officially listed in UK, partly because of susceptibility to *Ascochyta fabae*.

Autumn sowing of spring beans and winter ticks

November sowings of spring beans at NIAB Cambridge on medium to heavy soils showed variation in winter survival among varieties. Horse bean types e.g. Stella Spring, Cockfield, were generally more hardy than tick beans but none were as hardy as the current winter beans. In the 1960s and 1970s some growers, in an attempt to obtain earlier crops, broadcast and ploughed in spring horse beans deeply during November or December (Bond, 1985). As a result, emergence was not usually until after severe winter frost, and generally satisfactory, early, crops were obtained unless the weather was unduly hard. (Whitton, personal communication).

A few favoured areas of the UK, e.g. Ingham, E. Coast of Norfolk, allow spring tick beans to be sown in the autumn. Deep soils near the Broads grow vigorous crops which rarely get frost-damaged because of the moderating influence of the sea. Some degree of hardiness was demonstrated in trials in Cambridge of one of these stocks but it was not sufficient to recommend this stock for autumn sowing much west of coastal Norfolk.

The Little English winter bean was a winter tick; but it must have been low yielding. Attempts to breed winter ticks from crosses between modern spring ticks and winter horse beans, such as in a cross between Maris Bead and Punch, resulted in hardy ticks but not with the round seed shape of Maris Bead or the yield and tillering ability to match their winter parent. The objective might still be valid because of the attractiveness of present day premiums for Maris Bead-type ticks.

Tannin-free winter beans

The white flower genes, *sp-a* and *sp-b*, (Ward and Chapman 1986) where they are present, are pleiotropically associated with the absence of tannin in the seed giving improved digestibility and allowing higher inclusion rates in animal feeding rations. Although white flowered varieties for spring sowing were described in the 19th Century (Wilson 1847), (Haxton 1855) and were free of tannin (Wilson 1907) we have not found any reference to winter hardy white flowered varieties until crosses were made at PBI in the 1980s to transfer the white flower gene to winter beans. This was done by crossing the white flowered broad bean Triple White (*sp-b*) with winter hardy *V. faba var equina* types. The first variety, Polar, entered UK official trials in 1980 followed in 1988 by Glacier which was an improvement in yield. Although initially recommended by NIAB, Glacier was withdrawn as yields did not equal tannin-containing varieties. Silver was National Listed in 1999. Though tannin-free spring beans, including near isogenic lines, indicate that tannin protects seeds and seedlings against *Fusarium*, this problem is not so marked in winter beans because, with October sowing, the soil is warmer than when spring beans are sown in March.

Winter Broad Beans

Traditional varieties of broad beans (*V. faba var major*) for autumn sowing in the UK are Aquadulce and Reina Blanca from Spain and Portugal. Some breeding has been carried out at Cambridge to try to develop winter hardy white flowered broad beans which might pod early enough to enter canning factories before spring peas. Additionally the level of hardiness among coloured flowering types is being increased beyond that of Aquadulce by crossing with the German winter variety Hiverna. However, none has entered commerce.

Chinese Winter Beans

Recent accessions to France from China are both winter hardy and early maturing (Ney and Duc, 1997). However they are susceptible to lodging and the seeds are of flat small *major* type. As the previous association between late maturity and winter hardiness seems to have been broken, these Chinese winter beans should be useful parents for breeding in the UK.

Conclusion

Winter beans have reached an advanced stage of adaptation to the climate and stresses

in the UK with increasing yields, though further improvements in maturity date, resistance to lodging and disease remain as breeding objectives. All UK winter beans are *equina* types but only since about 1920-1945. Prior to that period, winter beans were *minor* types and known as the Little English or Russian bean.

It is now clear that hardiness is not necessarily associated with small seed size or late maturity. It can be transferred and combined with *equina*, and perhaps *major* type characteristics as well as earlier maturity.

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Note

The winter bean breeding programme, which was at Cambridge for over 40 years, was transferred in July 1999 from Monsanto, Cambridge, to Wherry & Sons Ltd, Bourne, Lincolnshire.

References

- BOND, D. A. (1953). Some aspects of the field bean crop. *Honours dissertation*, University of Durham.
- BOND, D. A. (1985). Recent history of varieties and of the culture of field beans (*Vicia faba*, *equina* and *minor*) in the UK. *Journal of the Royal Agricultural Society of England*, 146, 144-159.
- BOND, D. A. (1989). Prospects for commercialisation of F1 hybrid field beans (*Vicia faba* L.). *Euphytica*, 41: 81-86.
- GREENWOOD, H. N. (1955). Experiments with field beans at the National Institute of Agricultural Botany; *Journal of the Royal Agricultural Society of England*, 116, 29-33.
- GREENWOOD, H. N. (1956). Field Bean "Varieties". *Agricultural Merchant*, 36, No. 11, 66-68.
- GREENWOOD, H. N. (1959). Investigations into field beans at the National Institute of Agricultural Botany; *Journal of the Royal Agricultural Society of England* 120, 70-77.
- HAXTON, J. (1855). Beans. In: *The Cyclopaedia of Agriculture Vol. 1* pp 198-213. Ed. J. C. Morton. Published by Blackie & Sons, London.
- KNOTT, C. M. (1997). The contribution of plant breeding to improvement in yield, agronomic and quality characters for field beans (*Vicia faba* L.). *Plant Varieties and Seeds*, 10, 65-80.
- LAWES, D. A., BOND, D. A., and POULSEN, M. H. (1983). Classification, Origin, Breeding Methods and Objectives. In: *The Faba Bean* ed. P. D. Hebblethwaite, Butterworths, London pp 23-76, especially p 41.
- LECHNER, L. (1959). Wicke (= Vicia) - Arten. *Handbuch der Pflanzenzüchtung*, 4, 52-95.
- LOUDON, J. C. (1825). An Encyclopedia of Agriculture. *Longman, Hurst, Rees, Orme, Brown and Green*, Paternoster-Row, London.
- MAFF (1998). *Ministry of Agriculture, Fisheries and Food*, Statistics Branch, York, YO1 2PX.
- MURATOVA V. S. (1931). Common beans - *Vicia faba* L. Supplement to the *Bulletin of Applied Botany, Genetics and Plant Breeding*, Leningrad, 293pp.
- NEY B., and DJC, G. (1997). The main constraints to overcome in the plant development for the winter type varieties. *Grain Legumes*, 16, 14-15.
- OLDERSHAW, A. W. (1943). Field Beans. *Journal of Ministry of Agriculture* 49, No. 5, 210-211.
- PERCIVAL J. (1908). Beans. In: *The Cyclopaedia of Modern Agriculture Vol. 2* p 85. Gresham Publishing Co., London.
- PERCIVAL J. (1935). *Agricultural Botany*, Eighth Edition, Duckworth, London.
- FGRO (1994). *Field Bean Handbook*. *Producers and Growers Research Organization*, Peterborough.
- PORTER, J. (1925). The Bean Crop. In: *'Farm Crops'* 270-284. Edited by Paterson W. G. R. Published by Gresham Publishing Co., London.
- SMITH, B. F. and ALDRICH D. T. A. (1967). Winter Bean Trials 1952-64. *Journal of National Institute of Agricultural Botany* 11, 133-146.
- STEPHENS H. (1871). *The Book of the Farm*. William Blackwood & Sons, Edinburgh and London.
- TÜSSER, T. (1573). Five hundred points of good husbandry. *Oxford University Press* reprint 1984.
- WARD, S. and CHAPMAN, G. P. (1986). Third Conspectus of Genetic Variation in *Vicia faba*. Supplement to *FABIS*, 15. published by ICARDA, Aleppo, Syria.
- WATSON, J. A. S. and MORE, J. A. (1949). *Agriculture, The Science and Practice of British Farming* p 365. Ninth Edition. Oliver and Boyd, London.
- WILSON, J. M. (1847). *Rural Cyclopaedia*. Published by A. Fullarton & Co, Steads Place, Edinburgh; and Newgate Street, London.
- WILSON, J. M. (1907). *The Farmers' Dictionary* Vol 1, p 160. Published by Fullarton & Co, Edinburgh.
- WRIGHTSON J. and WRIGHT, R. P. (1908). Beans. In: *The Standard Cyclopaedia of Modern Agriculture*, Vol 2, p 85. Gresham Publishing Company, London.
- YOUNG, A. (1804). *The Farmers' Calendar*, Richard Phillips, St Pauls, London.