Agronomic Treatises of the Medieval Muslims (10th century – 12th century A.D.)

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Before discussing the Islamic history of *filāḥa*, one should know the literal and technical meanings of this word. The word *filāḥa* has been derived from the root words *fā*, *lā* and *ḥa*. Ibn Manẓūr mentions the literal meaning of the word as follows:

> "Al-Falaḥ and al-Falāḥ: Prosperity or success; safety or security; and continuance or permanence in a good or prosperous state and in the enjoyment of ease, comfort, or the blessings of life and continuance of good. It is stated in the ḥadīth of Abī Daḥdāh: Bashsharaka Allāhu bi Khayrin wa Falaḥin i.e. May Allah give you the glad tidings of prosperity and continuance of the blessings of life."
>
> "Another meaning of *al-Falaḥ* is to cleave, split or cut. *Falaḥa al-Shay'a*: He split it apart. The poet said: "Indeed your horse knew that I am al-Sahsah, and verily the iron is cut with the iron."

"*Al-Falaḥ* is the transitive verb. *Falaḥtu al-Arḍa* is said when I ploughed or tilled it for cultivation. *Al-Fallāḥ*: A plougher, tiller or cultivator of land. He is called *fallāḥ* because he ploughs (cuts the

> surface of) the land. And his work is called *al-Filāḥah* which means tilling, cultivation, or ploughing. In the *ḥadīth* of 'Umar comes *ittaqū Allāha fi al-fallāḥīna*: Fear Allāh in the matter of cultivators or tillers or ploughers those who cut the surface of land." (1)

In technical term, the concept of *filāḥa*, according to Taufic Fahad, is "the culture and care which plants need." (2) In the view of Ibn Khaldūn:

> "It concerns the study of the cultivation and growth of plants through irrigation, proper treatment, improvement of the soil." (3)

While mentioning His bounties on mankind, Allāh Almighty has mentioned in the Surah al-Mulk that He has tamed the earth for us. The surface of the earth has been made such by Allah that tilling and plantation is possible. If the earth had been made of stone, gold or silver, it would have been impossible to grow anything from it. The verse says:

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﴿هُوَ الَّذِي جَعَلَ لَكُمُ الْأَرْضَ ذَلُولاً فَامْشُوا فِي مَناكِبِها وَكُلُوا مِنْ رِزْقِهِ وَإِلَيْهِ النُّشُورُ﴾

"It is He who made the earth tame for you - so walk among its slopes and eat of His provision - and to Him is the resurrection."(4)

The practice of tilling of the land has also been mentioned. While reminding the end of previous disobedient nations, Allāh Almighty has told that they were strong and used to plough their land. The verse in the Surah al-Rūm says:

﴿كانُوا أَشَدَّ مِنْهُمْ قُوَّةً وَأَثارُوا الْأَرْضَ وَعَمَرُوها أَكْثَرَ مِمَّا عَمَرُوها﴾

"They were greater than them in power, and they ploughed the earth and built it up more than they have built it up."(5)

Gardening has been mentioned in an incident told in the Surah al-Kahf. One of the two brothers mentioned in the surah was given gardens. The verse says:

﴿وَاضْرِبْ لَهُمْ مَثَلاً رَجُلَيْنِ جَعَلْنا لِأَحَدِهِما جَنَّتَيْنِ مِنْ أَعْنابٍ وَحَفَفْناهُما بِنَخْلٍ وَجَعَلْنا بَيْنَهُما زَرْعاً﴾

"And present to them an example of two men: We granted to one of them two gardens of grapevines, and We bordered them with palm trees and placed between them (fields of) crops."(6)

The Holy Prophet (peace be upon him) urged the Muslims to cultivate land in a famous hadith. He said:

" مَنْ كَانَتْ لَهُ أَرْضٌ فَلْيَزْرَعْهَا أَوْ لِيُزْرِعْهَا أَخَاهُ وَلاَ يُكْرِيهَا أَخَاهُ "

"Whoever has land, let him cultivate it or give it to his brother to cultivate, and not lease it to his brother."(7)

Based on the teachings of the Holy Qur'ān and ḥadīth, Muslims of the medieval period had shown great interest in the field of agronomy. The Islamic tradition of agronomy of the medieval period begins with a monumental work, *Al-Filāḥah al-Nabaṭiyyah* (Nabataean Agriculture), which is claimed to be pre-Islamic in origin and has translated from ancient Syriac into Arabic by Ibn Waḥshiyya (d. 318/930–1) whose full name was Abū Bakr Aḥmad b. ʻAlī b. Qays al-Kaldānī. He was from Qusayn near Kūfah in Iraq, and also made a long stay in Egypt. He wrote that he searched for the science works of his ancient ancestors until he found them and translated them into Arabic.(8) Ḥājī Khalīfah claims that he was one of the translators who were employed by the Abbasid Caliphs to translate the ancient Mesopotamian work (*Nabataean*) into Arabic.(9)

Al-Filāhah al-Nabaṭiyyah (Nabataean Agriculture)

"Al-Filāḥah al-Nabaṭiyyah (Nabataean Agriculture)" is a tenth-century treatise by Ibn Waḥshiyya which reflects the agricultural practice of central Mesopotamia (around Kūfah). This is based on works written by a group of scholars who were the ancient inhabitants of Mesopotamia. In the end, the work was put together by an author called Quthāmā. According to

Hämeen-Anttila, "its contents are a mixture of practical advice on agriculture, theoretical speculation on the influence of stars and elements on plants, together with charms and magical procedures and a huge amount of folklore, myths, ancient stories and religious information".(10)

The authenticity of the Nabataean corpus has been disputed by the scholars. Étienne Quatremère (1835) and Daniel Chwolsohn (1850s) acclaimed it as a genuine piece of Babylonian literature. However, Alfred von Gutschmid (1861) and Theodor Nöldeke (1876) criticized it due to inconsistencies present in it.(11) The botanist E.H.F. Meyer, though admitted that the text was a forgery, had accepted its value of the work for botanical and agricultural studies.(12) Hämeen-Anttila concludes, "it contains much material that has to be genuine in the sense that it is not fictitious but describes the existing rituals, beliefs and magic of the population of Iraq, either in the centuries before the Islamic conquest or soon after it."(13)

The Nabatean Agriculture provides the basis for ancient and medieval agronomy. This is a significant book on plants and agriculture which encompassed much of the information of ancient Chaldeans regarding their principles of agriculture, the types of crops they used to plant, the ways of storage, the methods of use and protection from pests. At many places, he also tells new ways of agriculture.(14**)**

A critical edition of this compendium has been edited by Taufic Fahad in 1993 entitled: *"Al-Filāḥah al-Nabaṭiyah: Al-tarjamah al-manḥūlah ilá Ibn Waḥshīyah, Abū Bakr Aḥmad ibn 'Alī ibn Qays al-Kasdānī* published by *al-Ma'had al-'Ilmī al-Faransī lil-Dirāsāt al-'Arabīyah*, Damascus."(15) According to this edition, "it consists of over one hundred and fifty chapters of varying lengths.The first section deals with olive trees. The second one deals with water which conditions agriculture. The third one deals with aromatic floral plants. The fourth one deals with trees and bushes with medicinal properties. The fifth section can be called a handbook for the agriculturalists. The sixth one deals with leguminous plants and grains. The seventh one studies wild plants. The eighth one is dedicated to phytobiology and the morphology of plants. The ninth one is dedicated to vegetables. The tenth one is dedicated to the vine. The eleventh concerns tress: fruit trees and forest trees. The twelfth is dedicated to autogenesis of plants and to the art of reproducing or imitating nature. The thirteenth is dedicated to date palm."(16)

Next important contribution to the field of agronomy by a Muslim agronomist is "*Majmū' fī 'l-filāḥa".* This treatise was compiled by an Andalusī, Ibn Wāfid (d. 467/1075), whose full name was Abū al-Muṭarrif 'Abd al-Raḥmān b. Muḥammad b.'Abd al-Kabīr al-Lakhmī. He lived in

Toledo in the days of Ibn Dhū al-Nūn. He was born in Dhū al-Ḥijjaḥ 387/997 and was still alive in 460/1067. He devoted himself to the study of Galen and also read Aristotle and other philosophers.(17)

Majmū‘ fī ’l-filāḥa (Compendium of Agriculture):

An agricultural treatise, *Majmū‘ fī ’l-filāḥa* (Compendium of agriculture) has been attributed to Ibn Wāfid. Interestingly, there is no extant Arabic manuscript of this work with the name of Ibn Wāfid as author, but there is a late 14th/early 15th century C.E. copy of an earlier Castilian translation of the *Majmū‘* attributed to a certain *‘Abel Mutariph Abel Nufit’*, who according to Millás Vallicrosa must be identified with Abū ’l-Muṭarrif ibn Wāfid.(18) This is supported by the statement of Ibn al-Abbār:

> “He (Ibn Wāfid) wrote a very interesting compendium of agriculture, having mastered all aspects of the science, and was responsible for planting the famous garden of the ruler Al-Ma’mūn in Toledo.” (*19*)

Ruggles describes it as: “the compendium is divided into eighty-seven chapters plus an agricultural calendar towards the end. The chapters deal with soil types; water and how to detect its presence in the soil; the most suitable seasons for building farmhouses; fertilizers; seed selection; things that damage grain (such as hailstorms); when to sow wheat and barley; when to reap; the threshing barn; granaries and bakeries; how to select sites for vineyards; choosing vine shoots to plant and how to plant them; olive oil preparation; and the soil preparation for and sowing of lettuce, cabbage, chard, turnips, radishes, onions, leeks, garlic, celery, basil, cucumbers, melons, and sugarcane. More than fifty chapters of the original text are missing. Then, there is a set of specific instructions on when to plant, prune and harvest each type of plant and tree. It ends with a section on bee-keeping, pigeon-keeping, and pesticides such as myrtle and cumin.”(20)

The author of this text does not mention practical agricultural experience of his own, nevertheless, harbours a prodigious knowledge of the subject. Thomas Glick is of the view that the Majmū‘ has influenced the great work of agronomy, the *Obra de Agricultura* of Gabriel Alonso de Herrera (6th century C.E.). “He is one of the five frequently quoted works by Herrera. He has been cited one hundred and two (3 percent) times by him.”(21)

The medieval Castilian translation of Ibn Wāfid’s treatise was first edited and published by J. M. Millás Vallicrosa: “*La traducción castellana del Tratado de Agricultura de Ibn Wāfid*, Al-Andalus, VIII (1943), pp. 281-332; reprinted as *El Libro de Agricultura de Ibn Wāfid y su influencia en la agricultura del Renacimiento*, in *Estudios sobre la historia de la ciencia española*, 2 vols., Madrid, 1987.”(22)

A more recent edition and translation into modern Spanish is*: "Ibn Wāfid (1997). Tratado de agricultura: Traducción Castellana* (Ms. s. XIV). Edited (with Spanish translation, notes and glossary) by C. Cuadrado Romero. Anejos de Analecta Malacitana 14. Málaga: Universidad de Málaga."(23)

The Arabic text of *Majmū' fī 'l-filāḥa* by Ibn Wāfid has been published in two editions of agricultural works: "Al-Ishbīlī, Abū al-Khayr (1357/1938). *Kitāb fī al-Filāḥa*. Fez: Sīdī al-Tuhāmī al-Nāṣirī al-Ja'farī. Ibn Wāfid's treatise is on pp. 6-84; and the other is Ibn Ḥajjāj, Aḥmad ibn Muḥammad (1982). *Al-Muqnī' fī 'l-filāḥa*. Edited by S. Jarrār & Y. Abū Ṣāfiya. Ammān: Majma' al-Lugah al-'Arabiyya al-Urduniyya. Ibn Wāfid's treatise is on pp. 2-86."(24)

Another agronomist of Andalusia was Abū 'Abd Allāh Muḥammad b. Ibrāhīm (1050 -1100 CE) known as Ibn Baṣṣāl al-Ṭulayṭūlī. He used to serve at the botanical garden of king al-Ma'mūn b. Dhil Nūn in Toledo. Under the instruction of his mentor Ibn Wāfid, he journeyed to the east and collected seeds and plants for the botanical garden. After his return to Toledo, he applied the information he had gathered during his journey. When the Castilian king Alfonoso VI (1085) conquered Toledo, he took Ibn Baṣṣāl with him to Seville where he was given the charge of a botanical garden by al-Mu'tamid b. 'Abbād. The tradition of agronomy in Seville was characterized by him and his successors Abū al-Khyar al-Ishbīlī, Ibn al-Lūnquh and al-Ṭighnarī.(25)

Ibn Baṣṣāl penned the book *Kitāb al-Filāḥa* during his stay in Toledo. The original book is not available, but the manuscripts of an early summary are available. The summary is entitled as *"Kitāb al-Qaṣd wa'l-Bayān."* This summary was translated into Castilian probably in the court of Alfonso X of Castile (r.1252-1284). Julio Samso describes it as: "the work deals with waters, soils, fertilizers, preparation of the land, the cultivation of trees and other vegetables. In the end there is some advice on domestic economy."(26)

Kitāb al-Qaṣd wa'l-Bayān (The Book of Concision and Clarity):

The abridgement of Ibn Baṣṣāl's work comprises sixteen chapters: "The first chapter examines water of four kinds (rain water, river water, spring water, and well water). The second chapter examines the ten types of lands and soils (soft, heavy, mountain, sandy, black manure land, white, yellow, red, rough and stony land, and, reddish sandstone land). The third chapter deals with manures of seven kinds (equine, human, sweepings and refuse, that from sheep, and pigeons, ashes from bathhouse furnaces, and, lastly, artificial compost made from grasses, weeds and dry leaves).The fourth chapter discusses the indicators by which the farmer can determine

the quality of land. He advises on the ways to prepare land and organize it for cultivation, and how to ensure that water circulates properly, if it is irrigated."(27)

"The fifth chapter comprises fifty-three sections and examines the species of trees, including fruit-trees and explains different methods of propagation by seed or stone, shoots, cuttings and grafts. The next chapter is brief and sheds more light on some methods of propagating the trees already mentioned. The seventh chapter is also very short and deals with the pruning of trees."(28)

"The eighth chapter is devoted to the operation of grafting. Ibn Baṣṣāl discusses in great detail the determinants of grafting and discusses the five general types of graft: the Roman graft (between bark and wood), cleft graft, tube graft, shield graft, and drill or awl graft. The ninth chapter complements the previous chapter in discussing more of grafting, especially in making grafts between trees of very different natures, for example, between the olive and the fig tree." (29)

"The tenth chapter is very long and includes the cultivation of herbaceous plants, grains and vegetables. However, the chapter does not include the cereals: wheat, rye, barley, etc. The eleventh chapter continues with the cultivation of plants used as spices and flavourings, such as cumin, caraway, fennel, anise, coriander, etc. The twelfth chapter concerns the cultivation of plants typical of larger gardens and irrigated land and the next one is devoted to bulbs and root plants. The fourteenth chapter is given to the cultivation of leaf vegetables. The fifteenth chapter deals with aromatic plants. The last chapter gives some useful knowledge concerning water, wells, the preservation of fruits, etc."(30)

Ibn Baṣṣāl's treatise, *Kitāb al-Qaṣd wa'l-Bayān*, was translated into Castilian in the 13th century. It was edited by Millás Vallicrosa in 1948 as: "*La traducción castellana del 'Tratado de Agricultura de Ibn Baṣṣāl* which was reprinted in 2001 under the title Agriculture. Texts and Studies 5 in (Natural Sciences in Islam 24) edited by Fuat Sezgin and published by Institut für Geschichte der Arabisch-Islamischen Wissenschaften, Frankfurt. In 1995, an edition entitled *Libro de Agricultura* with Spanish translation and notes by J.M. Millás Vallicrosa & M. Aziman was published by Instituto Muley El Hassa, Tetuan". (*31*)

A contemporary of Ibn Baṣṣāl was Ibn Ḥajjāj. Born in Seville, his full name was Abū 'Umar Aḥmad b. Muḥammad b. Ḥajjāj al-Ishbīlī. He wrote a treatise entitled *Al-Muqni' fī 'l-filāḥa* (Sufficiency in Farming) in 466/1073. (32)

Al-Maqna‘ fī ’l-filāḥa (Sufficiency in Farming)

Ibn Ḥajjāj was the most learned of the Andalusi agronomists. No complete copy of his work is available to us today, but he is the principal source of Ibn al-‘Awwām who gives much respect to him as he mentions in the introduction of his book:

> “When I come to discuss the cultivation of lands, I always give precedence to the principles established by the Shaykh al-Khatīb Abū ‘Umar Ibn Ḥajjāj in his book, which has as its subject the theories of the ancients” (33)

With the help of available manuscripts the Arabic text of *Al-Maqna‘* has been published as: “Ibn Ḥajjāj, Aḥmad ibn Muḥammad (1982). *Al-Maqna‘ fī ’l-filāḥa* . Edited by S. Jarrār & Y. Abū Ṣāfiya. Ammān: Majma‘ al-Lugah al-‘Arabiyya al-Urduniyya, pp. 85-123.”.(34) There also exists a Spanish translation of it: “Carabaza Bravo, J. M. (1988). *Aḥmad b. Moḥammed b. Ḥajjāj al-Ishbīlī: Al-Maqna‘ fī ’l-filāḥa*, doctoral dissertation, University of Granada, 1988, I, 178-281.”(35)

Taufic Fahd comments about it: “Ibn Ḥajjāj’s work is important as it introduces in the Arabic agronomy the Latin agronomic tradition represented by Varro (first century BC) and Columella (first century AD). He quotes frequently from the classical agronomic texts, citing 23 authors in an indirect manner. His most frequent citation (28 times) is Yūniyūs who is probably Junius Moderatus Columella of Cadiz, or Vindanius Anatolius of Beirut.”(36) There also exist some similarities between the works of Columella and Ibn Ḥajjāj in the manner of citation, in the introduction, and in terms of knowledge and agricultural practices.(37)

Another Spanish contributor is Abū al-Khayr al-Ishbīlī, the Shajjār, who wrote the book *“Kitāb al-Filāḥa”* (Treatise on Agriculture) somewhere in 1073. Not much is known about his life except that he was born in Seville.(38)

“Kitāb al-Filāḥa” (Treatise on Agriculture)

Abū al-Khayr al-Ishbīlī was a disciple of Ibn Baṣṣāl and often cites him along with other ancients. Although his treatise exists in an incomplete form, but gives valuable information on the cultivation of crops and plants. He is esteemed by Ibn al-‘Awwām for his knowledge of soils, irrigation, the construction of wells, and cultivation of olives.(39) For the cultivation of olives he suggests three ways: “by cuttings, by layering, and that of sowing, or propagation by stone or pit.” According to him, “flax thrives on sandy, well-rested land. It needs a very loose soil, requiring several successive ploughings at judicious intervals. The cotton plant likes loose, broken up ground and the rainy season is the most favourable for sowing. Madder is

sown in March which prefers chalky-clay soil, a little sticky and well-manured." (40)

Another disciple of Ibn Baṣṣāl was Abū ʻAbd Allāh Muḥammad b. Mālik al-Murrī, Al- Ṭighnarī (d. after 1087). He lived at the court of Abū ʻAbd Allāh b. Buluggīn b.Badis (r. 1073-1090) who ruled over Granada. His treatise on agriculture entitled *Kitāb Zuhrat al-Bustān wa-Nuzhat al-Adhhān (Book of the glory of the garden and recreation of the minds)* comprises twelve parts and three hundred and sixty chapters.[41] He was not only a theoretical agriculturist, but carried out his experiments in the royal gardens of the Al-Sumādihīya palace in the ṭā'ifa kingdom of Almería.(42)

Kitāb Zuhrat al-Bustān wa-Nuzhat al-Adhhān *(Book of the glory of the garden and recreation of the minds)*

The author has dedicated his book to the Almoravid governor of Granada Abū 'l-Ṭāhir Tamīm b. Yūsuf b. Tāshfīn (r. 1107-10 and 1121-26). García Sánchez concludes that it was written in the first decade of the 12th century. There is only one copy of the original text of Al-Ṭighnarī's treatise which has been edited with introduction by E. García Sánchez in 2006. According to this edition, "there is a prologue which discusses general matters concerning agriculture. After the prologue, the treatise begins with an agricultural calendar of an astronomical and meteorological nature which includes references to magic, local traditions, the experiences of farmers. Then the main body of the work discusses the following subjects: Soils, manures and fertilizers, hydrology, general practical rules for farmers, domestic economy, the propagation of various trees and shrubs, treatment for the prevention and cure of their diseases and pests, as well as the care and methods needed to cultivate them successfully. At the end of the section devoted to each plant, the author describes its medicinal and nutritional value. He has also discussed grafting, the planting and cultivation of various cereals, vegetables and garden plants, etc."(43)

The most notable Spanish agronomist of the medieval period is Ibn al-ʻAwwām al-Ishbīlī, the author of the outstanding treatise on agriculture *Kitāb al-Filāḥa*. His full name is *Abū Zakariyā Yaḥyā b. Muḥammad b. Aḥmad b. al-ʻAwwām* and he flourished during the 12th century, at Seville.[44] He is the only agronomist mentioned by the historian Ibn Khaldūn,(45) and is noted too by the early 15th century encyclopaedist Al-Qalqashandī.(46) But both of them do not give his biographical details.

Kitāb al-Filāḥa:

Ibn al-ʻAwwām's *Kitāb al-Filāḥa* is the most significant Andalusi treatise on the subject of farming. It was the first Andalusi treatise to be published and translated into a modern language, initially into Spanish by Banqueri in

1802, then into French by Clément-Mullet in 1864–67, and subsequently into Urdu in 1927.(47)

Thomas Glick describes it as: "This is a huge compendium which is considered to be the most comprehensive agricultural treatise. He has gathered all the knowledge from all previous agricultural traditions and treatises. It contains one thousand nine hundred direct and indirect citations, a fact which makes it an enriched source of information on agronomy. 32.5 % of these citations are to the Byzantine sources, especially the *Geoponika* of Cassianus. 31% are to the near eastern sources, especially Ibn Waḥshiyya and 36.5% are to the earlier Sevillian agronomists. In the areas of arboriculture, olive and grape cultivation, and cereals his reliance is mainly on the classical sources. The part on soils and fertilizers is taken mainly from the Near Eastern sources. And Andalusi sources have been used in sections on irrigation, grafting and pruning, garden vegetables, condiments and flowers."(48)

Apart from the citing his predecessors, he often adds his own observations and experiences. For example, "he records his experiments in grafting the wild olive of the mountains with the domesticated olive of the plain, and his successful cultivation of saffron, under irrigation, in the mountains."(49) Regarding his experiments he says:

> "As for my own contribution, I put forward nothing that I have not first proved by experiment on repeated occasions" (50)

There are thirty four chapters of Ibn al-'Awwām's treatise which expound the following themes: "the nature of soils, irrigation techniques, working the land according to its specificities, grafting, cultivation of fruit trees, market, vegetable and flower gardening, pruning and trimming, etc. Certain chapters are on animal husbandry. He also wrote on drip irrigation, rice farming, artificial fertilization of date palms, acclimatization of vegetables and spices like cucumbers, gherkins and saffron."(51) Sarton comments on the book in the following words:

> "Ibn al-Awwām's treatise deals with 585 plants, and explains the cultivation of more than fifty different fruit trees. It contains striking observations on the different kinds of soil and manure and their respective properties, on various methods of grafting, on sympathies and antipathies between plants, etc. The symptoms of many diseases of trees and vines are indicated as are also methods of cure."(52)

Greene remarks: "There are two early Arabic texts with Spanish and French translation of the *Kitāb al-Filāḥa*. The Spanish translation came in 1802 in 2 volumes by J. A. Banqueri, Madrid entitled *Libro de agricultura.* The French translation came in 1866 in 2 volumes by J.-J. Clément-Mullet

entitled *Le Livre de l'Agriculture".*(53) Sarton considered the text and translations unsatisfactory.[54] However, both the Spanish and French translations have been revised and republished as:

"Ibn al-'Awwām (1988). *Libro de agricultura* (facsimile of 1802 edition, ed. and trans. into Spanish by J. A. Banqueri). 2 vols. Preliminary study and notes by E. García Sánchez and J. E. Hernández Bermejo. Madrid: Ministerio de A.P.A. and Ministerio de AA. EE."

"Ibn al-'Awwām (2000). *Le Livre de l'Agriculture*. Translated into French by J.J. Clément-Mullet. New edition with an introduction by M. El Faïz. Arles: Actes Sud - Paris: Sindbad." (55)

A previously unpublished part of the text about pruning grapevines was published and translated into Italian by Sul Taglio in 1889.(56) Some extracts from Ibn al-'Awwām have been translated into English and published as: Lord, P. (trans.) (1979). *A Moorish Calendar: from the Book of Agriculture of Ibn al-Awam*. Wantage: The Black Swan Press.(57)

Conclusion:

The medieval era marks the period of greatest Muslims' achievements in different disciplines of knowledge. One of such disciplines is agronomy. By the end of the ninth century A.D., most parts of land under the Islamic rule were undergoing through the process of extension of agriculture. Much of the land was being cultivated, many new crops were introduced, the use of irrigation techniques was widespread and there was a significant rise in the productivity of agricultural land. Although the agriculture was flourishing throughout the Muslim world, but it was al-Andalus where it reached its glory.

The Muslim tradition of agronomy can be traced back to a significant treatise authored by Ibn Waḥshiyya entitled "*Al-Filāḥah al-Nabaṭiyyah"*. This is a voluminous book comprising practical advice on agriculture coupled with a huge amount of folklore and magical procedures. Between the tenth to the twelfth century A.D., especially during the Ṭā'ifa kingdom in the second half of the eleventh century, many books on *filāḥa* were written down by Andalusi agronomists: Ibn Wāfid, Ibn Baṣṣāl, Ibn Ḥajjāj, Abū al-Khayr al-Ishbīlī, al-Ṭighnarī and Ibn al-'Awwām. They were the inheritors and transmitters of the tradition of the ancients including Byzantines, Romans, Greeks, Carthaginians and Chaldeans. They tested the inherited knowledge and compared it with their own experimental findings. Their books were both theoretical discussions on agronomy and practical manuals of the Muslim agronomists.

Ibn Wāfid authored an agricultural treatise "*Majmū' fī 'l-filāḥa"*, a compendium consisting of eighty seven chapters with an agricultural

calendar towards the end. Ibn Baṣṣāl's treatise, "*Kitāb al-Qaṣd wa'l-Bayān"* comprised sixteen chapters dealing with agriculture with some advice on domestic economy in the end of the treatise. "*Al-Maqna' fī 'l-fìlāḥa "* by Ibn Ḥajjāj was so important in the eyes of Ibn al-'Awwām that it became the principal source of his treatise. Ibn Ḥajjāj introduced in the Arabic agronomy the Latin agricultural tradition represented by Varro and Columella. Ibn Baṣṣāl's disciple Abū al-Khayr al-Ishbīlī gave valuable information about the cultivation of crops and plants in his treatise "*Kitāb al-Filāḥa"*. Another disciple of Ibn Baṣṣāl, al-Ṭighnarī was a practical agriculturalist who authored the book "*Kitāb zuhrat al-bustān wa-nuzhat al-adhhān"* in 12 parts and 360 chapters. The most notable among the Andalusi agronomists was Ibn al-'Awwām. He gathered all information about the agriculture from Byzantine, Near Eastern and Sevillian sources. There are thirty four chapters of his treatise "*Kitāb al-Filāḥa"* which deal with 585 plants, and it explains the cultivation of more than fifty different fruit trees.

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