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AGRONOMIC IMPORTANCE OF THE FABACEAE FAMILY: A SYSTEMATIC REVIEW

IMPORTÂNCIA AGRONÔMICA DA FAMÍLIA FABACEAE: UMA REVISÃO SISTEMÁTICA

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RESUMO

Este artigo de revisão aborda a família Fabaceae, que se trata de uma das maiores famílias botânicas quanto ao número de espécies, e que é uma família muito importante do ponto de vista agrícola. Com base nisso, o objetivo deste trabalho é evidenciar e caracterizar as principais espécies botânicas da família, que possuem algum interesse agrônomo, descrevendo suas principais características morfológicas, seus hábitos e também sua distribuição no planeta, citando onde as referidas espécies são mais empregadas e com qual intuito elas são utilizadas. Para o embasamento deste artigo, foram utilizados materiais publicados no período de 2003 a 2019, encontrados em revistas científicas eletrônicas e repositórios *on-line*. Contudo, este trabalho aborda a importância e as características agrônomicas de alguns dos gêneros da família Fabaceae, destacando sua relevância em relação aos aspectos econômicos. Portanto, almeja-se que este artigo de revisão possa servir como embasamento para outros trabalhos acadêmicos que busquem por informações que envolvam a temática abordada neste trabalho.

Palavras-chave: agronomia, agricultura, economia, botânica, diversidade.

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ABSTRACT

This review article addresses the Fabaceae family, which is one of the largest botanical families in terms of number of species, and which is a very important family from the agricultural point of view. Based on this the objective of this work is to highlight and characterize the main botanical species of the family, which have some agronomic

interest, describing their main morphological characteristics, their habits and also their distribution on the planet, citing where these species are most used and with which they are used. For the base of this article were used materials published from 2003 to 2019, found in electronic scientific journals and *on-line* repositories. However, this work deals with the importance and the agronomic characteristics of some genera of the Fabaceae family, highlighting their relevance in relation to economic aspects. Therefore, it is hoped that this review article may serve as a basis for other academic works that search for information that involves the theme addressed in this work.

Keywords: agronomy, agriculture, economy, botany, diversity.

1. INTRODUCTION

The botanical family Fabaceae, also known as Leguminosae, is considered a group of plants with cosmopolitan distribution, due to the fact that it is possible to find representatives of this group practically all over the world (SOUZA, 2012).

The plants that constitute this family have as main characteristic the fact that their fruits present in the form of "pod", although there are some exceptions. It has several species ranging from herbaceous to arboreal, and most of these are of great importance for human consumption and animals of the regions where they are found, as is the case of soybean (*Glycine max* (L.) Merrill) and beans (*Phaseolus vulgaris* L.).

The Fabaceae family species, besides having great importance for food, still stand out as to their values for medicine and economy, due to the great variety of products and substances purchased from these plants, such as medicines, oils, fuels, wood, fibers and others (LUZ, 2016).

According to Corby (2011), agriculture also benefits from the Fabaceae family, being used as fodder plants and improving soils destined to crops, due to the fact that the leguminous plants are able to perform the nitrogen fixation through symbiosis with bacteria in nodules in the root system. This characteristic is little noticed in species of the subfamily Caesalpinioideae, being more observed in species of the subfamilies Mimosoideae and Papilionoideae.

2. MATERIALS AND METHODS

2.1 Methodology

The present work is a review article and was based on a bibliographical survey from 2003 to 2019 on genera and species belonging to the Fabaceae family, aiming mainly at the agronomic importance of legumes.

The academic works and literatures used for the elaboration of this article were acquired through searches in electronic scientific journals and online repositories such as the Scientific Electronic Library Online - SciELO, and for the elaboration of this article a total of 24 articles and materials were used the botanical family Fabaceae published in the aforementioned period of time. Regarding inclusion criteria, these were work related to the botanical family Fabaceae published during the last sixteen years.

The exclusion criterion were published in languages other than Portuguese and English during the last sixteen years. The descriptors used for research purposes were "Fabaceae" + "Agronomic importance", "Fabaceae" + "Agriculture", "Fabaceae" + "Economy" and "Fabaceae" + "APG III".

3. RESULTS AND DISCUSSIONS

3.1 Classification of the Fabaceae Family

According to Carvalho (2009), the family Fabaceae belongs to the Plantae Kingdom and is part of the evolutionary group of Angiosperms, whose seeds are protected by fruits, and belongs to Fabales order.

The Fabaceae family is subdivided into three subfamilies (Caesalpinioideae, Mimosoideae and Papilionoideae), which comprises about 18.000 to 20.000 species distributed in approximately 650 genera, being thus one of the largest families in terms of number of species among the Angiosperms, losing only to Asteraceae, which has about 24.000 species and Orchidaceae, with approximately 25.000 species (LUZ, 2016; SILVA et a., 2013).

In Brazil, about 200 genera and approximately 500 species are recorded (Gonçalves, 2012), which can be found in practically all national ecosystems due to the wide variety of plants that can occur in several ecosystems.

3.2 Genders and species with agronomic importance

Several plants of the Fabaceae family can be considered of great agronomic importance, since they present several characteristics, for example, they are efficient in their productivity, they facilitate the development of other crops, they are used in human and animal feeding, among others.

Fortunately these are very evident characteristics in the species of this family, being these considered plants of extreme importance for agriculture, economy and food in practically all the world. An example of this is the fact that several species of this botanical family are frequently used in agriculture for crop shading, green manure practices, soil cover and recovery of degraded areas (MORETI, 2006).

The ability of many leguminous plants to associate symbiotically with bacteria of the genus *Rhizobium* that are fixers of atmospheric nitrogen is a well-exploited property in agricultural production systems, as it provides a better development for cultivated plants (COLETTA, 2010; SANTOS, 2012).

This family also has great participation in the economy and food of the population in the region where they are, thanks to a great variety of species used for alimentary purposes and consequently in the commerce, as it is the case of beans, soybean, peas, beak, lentil and many others that are sources of proteins and micronutrients that can be beneficial to the health of those who consume them (YAHARA et al., 2013).

The great use of Fabaceae species in both agriculture and trade and food make this family a very important agronomic group and therefore more detailed studies and encouragement to the conscious farms of these plants are necessary, since the same have a high value for those who consume them, regardless of their social and financial levels.

3.3 Some of the genera and species with agronomic importance

Several species of the Fabaceae family are considered of great agronomic value, since they are mainly produced and used by producers of the primary sector, generating income and opportunities for them to compete and participate in the labor market.

3.3.1 Genus *Arachis*

It is a genus that presents about 60 to 80 species, is widely used as fodder and in human food, so it is of great agronomic importance. It is composed of autogamous plants, with gene flow limited to small populations (SANTOS, 2012). The best-known species of this group is *Arachis hypogaea* L. (commonly known as peanut), which is a dicotyledonous, belonging to the subfamily Papilonoideae, native to South America, and is considered one of the most produced oleaginous plants in the world (GRACIANO, 2009).

3.3.2 Genus *Bauhinia*

This genus presents about 300 species, which are known as the "cow's foot", due to the shape of its leaves. Its leaves and its suber has been used in popular medicine as a remedy for diabetes, infections, pain and inflammatory processes. The species of the genus present bifoliadas leaves, with diclamídeas flowers, dialipétalas, stamens generally free each other, its fruit is a vegetable presenting seeds with pleurogramas.

Within this genus, the *Bauhinia forficata* Link, which is a semi-deciduous, open-canopy tree with white flowers, arranged in axillary racemes, the fruits are of the legume type with flat pods and dehiscent of dark color at the time of opening (NOGUEIRA; SABINO, 2012).

The species *Bauhinia forficata* Link is an agronomic interest since research carried out by Nogueira; Sabino (2012) indicates that this species is of great interest for the pharmaceutical industries, because they present antioxidant, antimicrobial, anticoagulant, antifibrinogen and hypoglycemic activities.

3.3.3 Genus *Caesalpinia*

The genus *Caesalpinia* is composed of about 22 species, its plants have a great therapeutic potential, among the species of this genus the most known by the population are *Caesalpinia pyramidalis* L., *Caesalpinia ferrea* L., *Caesalpinia pulcherrima* L., which have a wide medicinal potential, are of great potential. Among the species of this genus, *Caesalpinia pyramidalis* L. Forget the *Caesalpinia echinata* Lam, popularly known as Brazil-wood, is a tree of great historical and economic value, which can reach up to 30 meters in height and features yellow flowers.

It is native to the Brazilian Atlantic Forest, its wood provides a red dye used in the textile industries, and also to manufacture bows for musical instruments such as violins, violas and cellos, Brazil-wood was one of the first Brazilian natural products to be marketed in large scale, in homage, it is said that the name of Brazil was inspired by this tree (COTA et al., 2011; MOURA et al., 2018). It presents agronomic importance because it is a genus that presents therapeutic properties that can be used in the pharmaceutical industries, and also in the production of wood, which is the case of *Caesalpinia echinata* Lam.

3.3.4 Genus *Cicer*

This genus is represented by approximately 44 species, its main representative being *Cicer arietinum* L., popularly known as chickpeas, which is one of the most important protein crops in the world, playing an important role in human needs in vegetable protein. The plant is herbaceous, presenting a great morphological variation in most of its characteristics, which will depend on the angle that the branches make with a vertical axis, its flowers present peduncle and are axillary, being typically papilionáceas, its fruit is a pod that produces 1 to 2 seeds (BORGES, 2009).

3.3.5 Genus *Copaifera*

The species *Copaifera* L., are of great agronomic and economic importance, the species of the genus are characterized by the production of copaiba oil, which is widely used for the production of herbal and cosmetic products. Species of this genus can be shrubs or trees that reach up to about 40 m in height, with composite leaves, alternating and paripinadas. The flowers are sessile, the inflorescence is of the racemosa type, with white and sessile coloration. The fruits are unilocular and become red when ripe and their seeds are ovoid, *Copaifera multijuga* L., whose oil is widely used in popular medicine as anti-inflammatories (BARBOSA; SCUDELLER, 2009).

3.3.6. Genus *Crotalaria*

According to Honório-Júnior et al. (2010), the genus *Crotalaria* presents about six hundred species in the world and more than forty in Brazil, some of the plants of the

genus are toxic to the animals, however, it presents a great value in agriculture, serving as green fertilization, acting in the vegetal cover of the soil assisting no-tillage. Among the many species of the genus *Crotalaria*, *Crotalaria incana* L., *Crotalaria juncea* L., *Crotalaria retusa* L., *Crotalaria sagittalis* L. and *Crotalaria verrucosa* L., *Crotalaria juncea* L., is one of the most used having origin in India, it is a shrub species, of erect growth and determined, is recommended for green fertilization in isolated cultivation, interspersed with perennials, is one of the fastest growing legume species, besides this use the species also produce high quality fibers and cellulose, own for the paper industry and other purposes.

3.3.7 Genus *Glycine*

The genus *Glycine* is formed by two subgenera, subgenus *Glycine*, consisting of 26 wild perennial species, and the subgenus soybean, which contains the species *Glycine* soy and *Glycine max*. This genus is of great agricultural and economic importance, due to its more known species that is *Glycine max* (L.) Merrill, this species has trifoliolate leaves, presenting flowers of white, purple or intermediate coloration, its fruit is a pods lightly arched, which, as they mature, evolve from green to pale yellow, light brown, brown or gray, and which may contain from one to five smooth, elliptic or globose seeds of pale yellow tegument with black thread, brown, or straw-yellow (NEPOMUCENO; FARIAS; NEUMAIER, 2009).

3.3.8 Genus *Indigofera*

The genus *Indigofera* presents approximately 700 species, all of which are distributed in tropical and subtropical climates. Most species of this genus are herbaceous and subshrub plants. The leaves are invariably composed imparipinadas and their inflorescence are racemic axillary type generally dense, pedunculated or rarely subsésseis, their flowers can present different colors like: pink, red, lilac, yellow, orange or green. Its fruit (legume) is linear, and can be straight or curved, cylindrical or flat shape, with several cube-shaped seeds. The most representative species of this genus are *Indigofera tinctoria* L. and *Indigofera anil* L., which are known popularly as anil, these species present great agronomic and economic value, due to the fact that this species is used for the extraction of their dye (anil) (PAULINO; PESSINE; TEIXEIRA, 2010).

3.3.9 Genus *Inga*

The genus *Inga* has about 300 species, its distribution is exclusively Neotropical, the species of the genus have as characteristics being, trees or arvoretas with leaves composed, paripinadas, nectaries foliar sessile or estipitados, its Inflorescences are axillary or caulifloras of the type racemo, its flowers are pentamiles, actinomorfs, hermaphrodites, gamossépalas, gamopétalas. Its fruits can be linear or curved, cross-section cylindrical, elliptical, quadrangular or compressed, its seeds are elliptic to oblong, wrapped around the forehead that proliferates in a sweet white pulp (sarcotesta), edible.

The genus has great agronomic and ecological importance, contributing to the natural balance, and also providing fruits and nectar, it species of the genus are also marked by producing radical nodules that contain bacteria fixing nitrogen of the air. One of the most well-known species of this genus is *Inga edulis* L., commonly known as "ingá-de-metro", the characteristics of this species reflect quite the general characteristics of the genus (POSSETTE; RODRIGUES, 2010).

3.3.10 Genus *Phaseolus*

This genus is composed of approximately 70 species, and is of great agricultural and economic importance, the characteristics of the genus are dictated by the species *Phaseolus vulgaris* L., popularly known as common bean, which presents a root system formed by a main root (pivoting), its stem is herbaceous, formed by a succession of knots and internodes, where from the third the leaves are trifoliolate, its flowers are arranged in racemic, axillary and terminal inflorescences.

The fruit is a dehiscent vegetable, with two valves joined by two sutures, one dorsal and one ventral, whose shape can be straight, arched or curved, the color varies according to the degree of maturation, being green, green with red or violet, red, purple, yellow, yellow with red or purple streaks, and in some cases even brown (SILVA; COSTA, 2003). According to Embrapa Rice and Beans (2012), beans have great socioeconomic, food and agricultural importance in all segments of the Brazilian population.

3.3.11 Genus *Pisum*

It is a genus very important for the economy and consequently it has agronomic importance, since its productions and cultures are used in the human feeding, being represented mainly by the species *Pisum sativum* L. (popularly known as pea), which is a herbaceous plant of the creeper type, which presents simple leaves and pod-type fruits, with rounded and green seeds (CAMPOS, 2014).

3.3.12 Genus *Vicia*

According to Theisen; Andres (2010), this genus corresponds to species of plants that have great utility in agriculture, where they are used in animal feeding and as a soil cover, one of the main benefits comes from its ability to supply nitrogen to subsequent cultures. The main species of this genus are: *Vicia sativa* L.; *Vicia villosa* Roth; *Vicia articulata* L.; *Vicia atropurpurea* L.; *Vicia pannonica* L.; *Vicia hirsuta* L. and *Vicia angustifolia* L. Among all the species we can highlight the *Vicia sativa* L., which is a herbaceous plant, of the climber type, which may have a hairiness or not, has a composite leaf with opposite phyllodia, ranging from four to seven pairs, their fruits are sessile pods, 6 to 8 times longer than broad.

FINAL CONSIDERATIONS

As mentioned in the review article, the Fabaceae family is quite extensive, and found practically all over the world, since it is a family with species that are easily adapted to the most varied ecosystems. This family is of great economic interest, due to its great versatility, and its species can be used both for human food, animal nutrition, for textile and medicinal purposes, as well as assisting in the cultivation of various other cultures, as they make symbiotic relationships with nitrogen fixing bacteria.

However, this review article may in future serve as a theoretical basis for several research purposes, since in the current available literature they do not group genera of a particular botanical family, emphasizing mainly their agronomic importance, so this article may help many who seek such information.

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