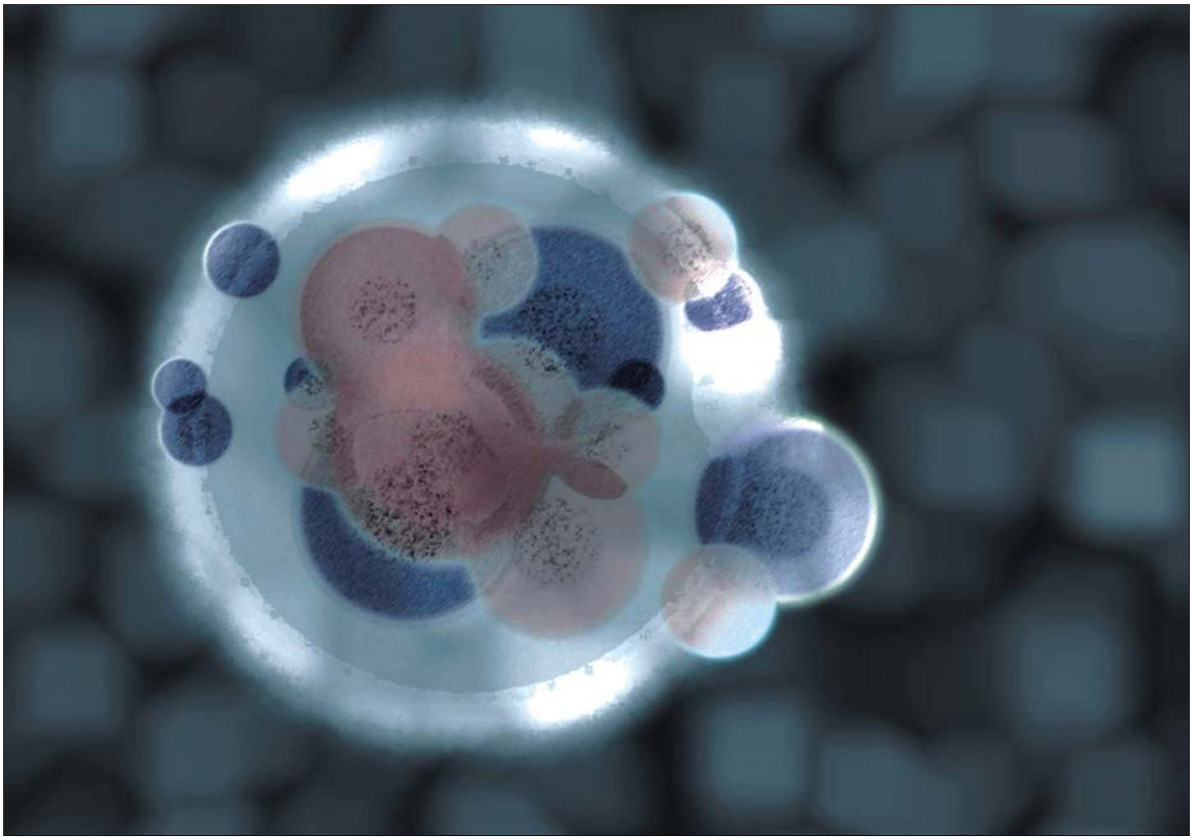

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Landrace Legumes: Synopsis of the Culture, Importance, Potentials and Roles in Agricultural Production Systems

I.I. Ibeawuchi
Department of Crop Science and Technology, Federal University of Technology Owerri,
P.M.B 1526 Owerri, Nigeria

Abstract: Most landrace legumes originated in Africa and Asia and their cultivation is as old as the existence of man's discovery of farming. Landrace legumes found in the humid and sub humid tropics with diverse climatic differences come from different groups and are found among wide range of species. Depending on the species, some are food/grain legumes, shrub or tree legumes. The major ones include mucuna pruriens, *Phaseolus lunatus*, *Sphenostylis stenocarpa*, *Mucuna sloanei*, *Pentaclethra macrophylla*, *Tetrapleura tetraptera* and *Anthonata microphylla*. They have potentials for man in his food and nutrition, soil fertility improvement through nitrogen fixation and mineralization of the decayed shoots and roots in the soil. They are important in soil conservation, farming systems and in medicine, agro forestry, for erosion control purposes and in culture of the people. Legumes are important crops and their nodules interact with rhizobia species of bacteria to fix nitrogen in the soil. They have high economic potentials when intercropped with yam/maize/cassava and as sole crops.

Key words: Landrace legumes, culture, potentials, importance, agricultural production

INTRODUCTION

Legumes apart from serving as food offer a variety of other uses including their ability to harbor nitrogen fixing bacteria and serve as green manure crops to improve soil fertility and soil organic matter content. The potential of legumes to fix nitrogen in the soils of lowland humid environment had not been fully exploited especially using the land race legumes of the rainforest belt of Nigeria. Technologies therefore, can be developed for using such edible land races like African yam bean (*Sphenostylis sternocarpa*) and Tropical lima bean (*Phaseolus lunatus*) and non-edible ones like the velvet bean, *Mucuna pruriens* var. utilis. These may serve as fallow green manure, cover crop or intercropping with yam, cassava and maize mixtures. Such mixtures may significantly suppress weed, reduce the amount of fertilizers applied to the associated crops, protect the soil and prevent soil erosion and moderate high tropical temperature. In this regard, the traditional management of these crops and cropping systems demands research interest.

The stable cropping system that has been used by our ancestors' for generations has invariably included the land race legumes adapted in their various cropping mixtures. This hitherto had helped to sustain soil fertility, especially the soil nitrogen content. With the neglect of these native legumes in preference to exotic ones during the colonial periods, the lowland humid environment cropping systems have been left without an acceptable candidate legume in the cropping mixtures.

Soil conservation is an important factor for the farmer and environmentalists. Any crop plant that helps to conserve the soil is always accepted and adopted more quickly especially in an agro-ecology with fragile environment. In the lowland humid tropics, rainstorm and heavy rains cause serious erosion losses on steep slopes or lands that have been cleared, especially after pre-planting operations. It is a common practice to use legumes as cover crops to control erosion. Soil conservation could be developed with the traditional landrace legumes whose luxurious foliage would act effectively in breaking the force of raindrops and splashes. The shading from their copious leaves could provide an effective mat, shielding the soil from direct impact of raindrops. Also, the pile of litters produced by these legumes will keep the soil cool during the hot dry season. The major legumes include *Mucuna pruriens* (the velvet bean), *Phaseolus lunatus* (Lima bean), *Sphenostylis stenocarpa* (African yam bean), *Mucuna sloanei* (Horse eye bean), *Pentaclethra macrophylla* (Oil bean), *Tetrapleura tetraptera* (Aidon tree) and *Anthonata microphylla* (Anthonata tree).

Legumes:

Brief history and culture: Leguminous plants are found everywhere in the world (NAS, 1979), but the greatest varieties grow in the tropical and sub-tropical regions. The cultivation of legumes is as old as that of cereals. Hence the archaeological evidence showed that legumes were cultivated before 500BC and that the earliest written records of the culture of soybean, perhaps the oldest cultivated legume, dated back to 3000BC in China Onwueme and Sinha (1991). Furthermore, the researchers stressed that there is also evidence that some legumes were cultivated in Central and Southern America from four to six thousand years ago. However, soybeans are important worldwide as source of high quality protein and the most important edible legume produced today followed by groundnut. Onwueme and Sinha (1991) reported that besides soybeans and groundnuts, other important legumes include lentils (*Lens esculenta*), which originated in Southwest Asia and have been important for food throughout history and had continued to be of significance in Asia and to a lesser extent in parts of Europe.

Cowpea: (*Vigna unguiculata*) is grown in tropical Africa. Various species of the genera *Phaseolus*, *Vicia* and *Cicer* are important legumes of Asia, Africa and Europe. Both the black gram (*Vigna mungo*) and green gram or mung (*Vigna radiata*) are grown extensively in India. The broad bean (*Vicia faba*) is well adapted to Northern Africa. India is the major producer of Chickpea (*Cicer arietinum*), also called garbanze or gram. These are also grown in the USA, Mexico, Spain and Turkey.

Legumes, when compared with other plant species in terms of usefulness to man had been found to be second in importance after the grasses (NAS, 1979; Mulongoy *et al*., 1992). Most plants are unable to assimilate atmospheric nitrogen but legumes are capable, totally or in part according to the species, of growing with or without the addition of nitric or ammonical nitrogen (Mulongoy *et al*., 1992). Many researchers had proved that legumes are capable of fixing atmospheric nitrogen in the soil due to the presence in their roots of bacteria the *Rhizobium* sp. and that the plant and the bacteria have a symbiotic relationship (Peoples *et al*., 1989; NAS, 1979; Ojeniyi, 2002; NRC, 1983). Ojeniyi (2002) pointed out that an indirect effect of N fixing by legumes on agricultural soil is the improvement of the physical condition of the soil by the nodule bacteria rhizobium, which produces copious amount of polysaccharides. Upon all these, NAS (1979), explained that enormous research resources have been expended on grasses such as rice, wheat, corn, sorghum, barley etc while among the legumes only a few of them such as cowpea, groundnuts, soybeans have come into prominence. Legumes have promising future in the cropping systems of the developing countries of the world because they produce the highly needed vegetable proteins that are lacking in most food dishes (Oke, 1975).

Taxonomically, Daisy (1979), NAS (1979) and NRC (1983) explained that legumes belong to the family leguminoseae. However, NAS (1979) and NRC (1983), maintained that there are approximately 650 genera and 18,000 species in this family. They highlighted that the leguminoseae is the third largest family of the flowering plants after compositeae and orchidaceae and that the family is divided into three sub families which include:-

Caesalpiniodeae: These are mainly trees of the tropical savanna and forests of Africa, South America and Asia. There are about 2,800 species in this family.

Mimosoideae: These are mostly conspicuous as small trees and shrubs of semi arid, tropical and sub-tropical regions of Africa, North and South America and Australia. There are about 2,800 species in this group.

Papilionoideae or Faboideae: These are mainly herbs and are distributed worldwide having about 12,000 species. According to Rachie and Silvestre (1977) all legumes bear pods and this singular character can easily identify them. However, the pods come in different shape and nature, thus they may be round, flat or winged, long or short, thick or thin, straight or coiled, papery or leathery, woody or fleshy. Some of the pods are not much bigger than a pinhead, others may be the size of a tennis ball while others may be more than one meter long (Menninger, 1962, 1970; Westphal, 1974; Herklot, 1976; NAS, 1979). The pod split lengthwise at one or both edges to expose and release the seeds, which normally range from one to several numbers that the pod may contain.

Shrub and tree legumes: Shrub and tree legumes serve a multitude of purposes in agriculture and forestry, including forage for animal production, fuel wood and timber production, soil conservation and fertility improvement (NRC, 1983). Generally, legumes usually connote vegetables for the dinning table. However, for the agriculturists and plant scientists, they include not only vegetables but also thousands of shrubs, vines and tree species. Works at NRC (1983) and Wallis and Byth (1987) explained that many of the legume species are tropical trees whose potentials in plantations and farming systems remain largely untested.

Some leguminous trees appear to have special attributes that make them particularly promising in agriculture especially their ability to fix atmospheric nitrogen and for combating devastating tropical deforestation (CABI, 1995; NRC, 1983). According to O'Hara *et al.* (1988) and Peoples *et al.* (1989), many trees and shrubs are among the nature's pioneering plants and they usually colonize newly cleared lands. NAS (1979), NRC (1983) and Gutteridge and Shelton (1993), inferred that it is reasonable and ecologically wise to exploit their innate abilities and use them for revegetating eroded or weed smothered terrain, halting erosion and providing a protective ground cover for regeneration of slow growing forest species.

Furthermore, small fast growing tree legumes can meet our everyday wood requirements. According to Westphal (1974), NAS (1979) and NRC (1983), many of the world's most exquisite flowering plants are legumes. Even cultivating them might reduce logging elsewhere and thereby help space the remnants of our natural forest (NRC, 1984). Some well-known examples in the temperate region include Wisteria (*Wisteria* sp.), Laburnum (*Laburnum* sp.) sweet pea (*Lathyras ordoratus*) and butterfly pea (*Clitoria ternatea*). Studies point out that the largest number of ornamental leguminous shrubs and trees are found in the tropics (NAS, 1979). The report explained that some of the most characteristic plants of the tropics are legumes and include the flamboyant or Royal Poinciana (*Delonix regia*), the golden shower (*Cassia fisfula*) and the pink and white shower (*Cassia nodosa*), Pride of Barbados (*Caesalpina pulcherima*), orchid tree (*Bauhimia purpurea*, *Bauhimia variegata* and *Bauhimia monandra*). Others include cock's comb coral tree (*Erythrina crista-galli*) and the rain tree (*Samanea saman*).

Herbaceous legumes: The importance of herbaceous legumes particularly in the diets of the undernourished people of the world cannot be overemphasized. Food or herbaceous legumes are important and economical sources of protein and calories as well as minerals and vitamins essential to human nutrition (Oke, 1975). According to Daisy (1979) and NAS (1979), the seed legumes also called beans, pulse or grain legumes are second only to cereals as source of human and animal food. Nutritionally, pulses are 2-3 times richer in protein than cereal grains. Many researchers have recognized some herbaceous legumes such as winged bean, soybeans and groundnut to be rich in extractable oil. According to NAS (1979), legumes are a major source food in many parts of the world today and their ability to feed both man and animal has led to intensive research on many known and lesser known herbaceous and tree legumes of tropical and subtropical regions. However, most if not all the herbaceous legumes are needed in the cropping systems of the farmers not only for protein supplies in food but also for other enormous benefits to the soil especially add to the soil fertility.

According to Oke (1975), Rachie and Silvestre (1977), NAS (1979) and Daisy (1979), pulses are leading candidates in the world market today, contain between 20 and 40% and a few range between 40 and 60% more protein than almost any other plant product.

Utilization of leguminous species in our agricultural systems: According to Wallis and Byth (1987) technologies that are perceived by smallholder farmers as complex and requiring higher level of management skill or as involving a high level of risk than existing systems are unlikely to be adopted, even if it has been demonstrated that they are more profitable. Furthermore, farmers are always afraid of new technologies and this is more peculiar to those under subsistence farming systems that may recognize the need for conservation practices, but simply cannot afford or are not prepared to adopt any change to their farming systems which involve some risk or reduced yield. However, by practising intercropping either herbaceous, shrub or tree legumes fit effectively well into the cropping systems. Agroforestry consists of cultivating and maintaining perennial woody plants on the same area as staple crops and or combining them with livestock husbandry. It can be considered as land-use planning in agriculture involving exploitation based on staple, livestock husbandry and silviculture (Albert, 1990).

In Nigeria, the International Institute of Tropical Agriculture (IITA) has since 1976 been working on alley cropping a form of agro-forestry. It carried out series of researches on the re-introduction of trees in agricultural cropping systems with a view to protecting the topsoil, upgrading its fertility status and increasing yield (IITA, 1992). It was explained that agro-forestry system consists of growing food crops between hedgerows of fast growing usually leguminous trees and shrubs. As a management technique, the leguminous shrubs or trees hedge rows grown 4-8 m apart, are pruned back and kept to a height of 1 m or less in the growing season and farmers use the leaves and twigs as fodder or mulch. In the dry seasons (IITA, 1992), it was reported that farmers allow the trees to grow up to 4 m and then pollard again just before the rainy season starts, providing firewood, poles and stakes. The litters fertilize the soil. For example in the humid zone, *Leucaena* species produce as much as 15-20 tonnes of leaves and twigs containing more than 160 kg nitrogen, 150 kg potash and 15 kg phosphorus ha^{-1}. In long-term trials on a sandy soil in Nigeria, unfertilized maize yielded 83% more when leucaena pruning are added to the soil: 1.9 tonnes in the first year against 1.04 tones without. The alley cropped plot yielded 2 tonnes per hectare over the next three years with no other fertilizer whilst the control plot declined to an average of 0.43 tonnes (Harrison, 1987).

Legumes are needed in perennial pastures used for ruminant production. However, they are assuming a greater role in mixed farming practice where the legume contributes to sustaining crop yields and to protecting the environment. This occurs in the context of tree crops grown with pasture, annual crops rotated with pastures, annual crops rotated with pastures in a ley system, shrub legumes partially fed to livestock and grown with annual crops and annual crops intercropped with annual legumes (Humphrey, 1994).

Forage legumes and their potentials: According to CAB Int'l (1995), the introduction of forage legume into tropical farming systems has improved many different aspects of the productivity and sustainability of these systems. Furthermore (CAB int'l, 1995) reported that the capacity of legumes to fix nitrogen provides a source of essential nutrients through recycling to companion grasses and under conditions of low soil fertility, thereby stimulating the growth and improving the nutritive value of tropical pastures grazed stock. Thus, the success of the temperate legumes, such as white clover (*Trifolium repens*), subterranean clover (*Trifolium subterranean*) and Lucerne (*Medicago sativa*) in grazing systems has led to improvement in productivity in warm climates. However each legume crop is adapted to a particular environmental niche. As a consequence therefore, it was recommended that a range of tropical legumes be tested for performance in tropical environments, suitability being judged firstly by agronomic characteristics such as persistence under grazing, competitive ability with grasses, nitrogen fixing capacity and survival from pest, disease and environmental extremes (drought, low soil fertility, etc).

Summerfield and Roberts (1985), observed that grain legumes are widely grown in all the four continents and that the seeds contribute to human and farm animal nutrition and to industrial production while the crop residues are usually superior in nutritive value compared with the residues of cereals and other crops. Shrub legumes such as *Leucaena leucocephala* and *Gliricidia sepium* are traditionally grown in the humid tropics. These are used to define and defend boundaries and to provide shelter and fodder close to farm residencies (Atta-Krah, 1993). Cameron *et al.* (1993) stressed that more recently these shrub legumes are more widely planted in alley farming practice or with grasses for forage.

Nodulation and nitrogen fixation: Nitrogen is 80% of the atmosphere, however inadequate supply most commonly limit food production. Neither man, animals nor higher plants can use free atmospheric nitrogen; it must first be fixed, that is, combined with other elements such as hydrogen, carbon, or oxygen before it can be assimilated (NAS, 1979). Certain bacteria and algae have the ability to utilize gaseous nitrogen from the air (NAS, 1979b). Also, some microorganisms work symbiotically in nodules on roots of plants, with the plant providing food and energy for the bacteria, which in turn fix nitrogen from the air for their host (Peoples *et al*., 1989; NAS, 1979).

Furthermore, NAS (1979) and NRC (1983), explained that other kinds of bacteria and algae work independently and fix nitrogen for their own use, but that these are often limited in their activity because of the lack of a dependable energy supply. Free-living nitrogen fixers, from at least 25 genera and many taxonomic groups occur in diverse habitats, their oxygen requirement, a specific energy source, electron acceptors and other factors vary widely (Burris *et al*., 1978). Fixation of significant amounts of nitrogen is dependent upon a suitable carbon and energy supply. An adequate source of energy is one of the most critical limiting factors to nitrogen fixation by free-living organisms. NAS (1979) emphasized that energy may be obtained through breakdown of plant residues in soils and that only rich fertile soils harbor organic residues in amounts sufficient to provide significant energy for especially *Clostridium*, *Klebsiella* and *Azotobacter* sp. However, certain bacteria are favoured by root exudates of some plant genotype that are very efficient photosynthesizers. Exudates from such roots are selective energy sources for particular bacteria and this relationship is often referred to as an association symbiosis (Krieg and Tarrand, 1977; NAS, 1979). In an International symposium on nitrogen fixation, Krieg and Tarrand (1977) recommended that associative symbiosis be termed biocoenosis and emphasized that *Azotobacter paspali*, *Beijerinkia* sp. and *Spirillum lipoferum*, fit into this category. Furthermore, Burris *et al.* (1978), Krieg and Tarrand (1977) agreed that other bacteria carry out photosynthesis themselves but that these microorganisms are not considered highly important agronomically.

Bacteria that fix nitrogen in nodules on roots of leguminous plants are called rhizobia. Other microorganisms that produce nodules on certain leguminous plants are classified as Frankis species and are actinomycetes (Gutteridge and Shelton, 1993; NAS, 1979b). Nitrogen is a key element required for plant growth and the symptoms of soil N-deficiency range from poor yields to crop failure. Traditionally, soil N-deficiency that has been addressed by applying N-fertilizers was largely responsible for the great increases in rice yields after World War II and for the success of the Green Revolution in Asia. However, there remains a wide gap in N-fertilizer use between the developing and developed countries. Hence, nitrogen fixation is seen as an important source of helping and alleviating the N-deficiency syndromes of most crop yields in the developing countries. Nitrogen fixing microorganisms have been credited with fixing an estimated 175 tonnes of nitrogen annually and about 70% of our total nitrogen supply for suitable agricultural production, whereas the remainder is produced in chemical fertilizer factories (NRC, 1983; Gutteridge and Shelton, 1993).

Around the world, nitrogen deficiency is a wide spread problem in many soils used for the production of staple food crops. This led to the fact that in highly potential areas of the developing world, farmers can afford nitrogen fertilizers to increase cereal and tuber crops production. In less favoured areas, an alternative cheaper source of nitrogen in the cropping system is that fixed by the root nodule bacteria in food and forage legumes (Peoples *et al.*, 1989). In addition to the sparing existing soil nitrogen, nitrogen fixation by these legumes can provide significant inputs, which enter the soil organic pool and are released to companion or subsequent crops in the cropping system. Thus the contribution of a legume in any production system is dependent on the formation of nodules by strains of rhizobia species effective in N_2 fixation with the chosen legume crop. The amount of nitrogen fixed in *Rhizobium*-leguminous plant association varies with the bacteria and legumes as well as with environmental factors (NAS, 1979; NRC, 1983). Forage legumes usually fix more nitrogen than do grain legumes because carbohydrate requirements resulting from seed development are small, whereas with grain legumes, the developing large seeds impose a heavy demand on the carbohydrate supply. However the amount of nitrogen fixed is uncertain, because of the methods of measurement (NAS, 1979; NRC, 1983).

In available literature, Brockwell (1980), Brockwell *et al.* (1987) and People *et al.* (1989), there are three major groups of legumes, which can be distinguished on the basis of compatibility with a range of rhizobia in any farming system (Table 1A-C) At one extreme (A) is a group of legumes, which can form effective symbiosis with a wide range of strains. Members of this group are the tropical legumes nodulated by the cow pea type *rhizobium.* These rhizobia (Peoples *et al.*, 1989) are wide spread in tropical soils and legumes of this group rarely respond to inoculation yet nodulation failures may still occur because of low number of rhizobia in the soil or high levels of soil mineral nitrogen.

At the other extreme C the legumes have specific rhizobial requirements. These specifications are most relevant when the legume is being introduced into new areas. Response to this inoculation is usually successful provided adequate numbers of rhizobia are applied at sowing (Brockwell, 1980; Brockwell *et al.*, 1987).

The third and intermediate group of legumes (B) nodulate with most of the rhizobium, but effectively fix nitrogen with only a limited number of them. The inoculation and nodulation failures are more frequent because the inoculum's strain is unable to compete with the ineffective but established soil population of rhizobia (Brockwell, 1980; Brockwell *et al.*, 1987; Peoples *et al.*, 1989), However, O'Hara *et al.* (1988) stated that environmental conditions (temperature, water availability, soil pH), the level of availability of mineral nutrients in the soil and diseases of legumes may seriously affect nodulation and or nitrogen fixation, thus obscuring the beneficial effect, which are being sought.

The availability of soil N exerts the most significant control of plant yield in the humid and sub humid tropics. The primary goal of farmers is to maintain a high level of soil organic matter whose continual breakdown will remove this constraint (Humphreys, 1994). The legume/rhizobial symbiosis provides farmers with an inexpensive source of N whose production is environmentally sound. It will not involve the consumption of fossil fuel, as occurs in the production of fertilizer N, which contributes to global warming and decreasing the foreign exchange earnings of tropical countries lacking oil resources (Humphreys, 1994).

The velvet bean (*Mucuna pruriens* var. utilis): *Mucuna pruriens* (L.) DC var. utilis Wight Burck is a native of South Asia and Malaysia, but presently it is widely grown throughout the tropics (Skerman, 1977). It is a vigorously growing and twining annual plant and has a number of species and hybrids (Oudhia, 2001; Skerman, 1977; Onyenuga, 1968). The trailing vines and leaves are grown mostly for green manuring or as temporary pasture (CABI, 1995; Skerman, 1977; Oyenuga, 1968). According to Oudhia (2001) the Mucuna leaves are trifoliate, gray-silky beneath, petioles are long and silky and 6.3-11.3 cm while the leaflets are membranous. The terminal leaflets are smaller while the lateral ones are very unequal sided. Skerman (1977) noted that the leaves are large and smooth, the terminal leaf being rhomboidal-ovate and the lateral ones oblique, 20-25 cm long and 7.5 to 12.15 cm wide. However, Paul (1951), Oyenuga (1968) and Skerman (1977) described the plant as being slender, slightly ridged and extending from 3-15 m in length and are mainly grown on support. Among the important species are *Stizolobium*

Table 1: Grouping of Legumes on the basis of nodulation and N_2 fixation with a range of rhizobium species

(A)	Nodule effectively with a wide range of strain (Genera listed forming one loose group). *Albizia, Galactia, Psophocapus, Callindra, Alysicaypus, Gliricidia, Pueraria, Arachis, Indigofera, Rbyachosia, Calliandra, Lablab, Stylosanthes, Calopogonium, Lepedeza, Cajanus, Macroptilium, Tephrosia, Canavalia, Macrotyloma, Teramnus, Clitoria, Mimosa, Vigna, Crotalaria, Pachrhizus, Voandzeia, Dolichos, Pongamia, Zornia, Erythrina, Neonotonia.*
(B)	Nodulate with a range of strains but often ineffectively (Genera listed forming individual groups with some crossing between groups. Sub groups distinguished). *Acacia, Astragalus, Psoralea, Adesmia, Centrosema* (2 sub group) *Sesbania* (2 sub group) *Aeschynosmeue, Desmanthus, Desmodium* (2 sub group).
(C)	Nodulate effectively with specific strains only (Genera listed forming specific groups) *Cicer, Lotononis-Listia* (3 sub group), *Phaseolus, Coronilla, Lotus* (3 sub group), *Pisum, Glycin, Max, Lupinus* (2 sub group) *Trifplium* (many sub group), *Lathyrus, Hedysarum, Medicago, Melilotus, Trigonilla, Leus, Onobrychis, Vicia, Leucaena, Ornithopus.*

Source: Peoples *et al.* (1989)

deeringianum Bort *(Mucuna utilis)* or Florida or Deering velvet beans with black pods (Oyenuga, 1968; Skerman, 1977). In describing the floral part, Oudhia (2001), pointed out that dark purple flowers (6-30) occur in drooping racemes whereas Skerman (1977), indicated that flowers are borne in long white racemes with purple tinge. Furthermore, they noted that the pods numbering 10-14 in a cluster are borne singly 10-12.5 cm long, curved with grayish white pubescence of short silky hairs. The longitudinally ribbed pod is densely covered with persistent pale brown or gray trichomes that cause irritation blisters. Seeds are black (3-6 seeded) per pod, ovoid and 12 mm long (Sastry and Kavathekar 1990; Agharkar, 1991; Verna *et al*., 1993; Oudhia, 2001).

Mucuna pruriens, a leguminoseae, is one of the popular medicinal herbs of India and it is a constituent of more than 200 indigenous drug formulations (Oudhia, 2001). It is widespread over most of the subcontinent and is found in bushes and hedges and dry deciduous low forests throughout the plains of India (Agharkar, 1991; Singh *et al*., 1996). All parts of mucuna posses valuable medicinal properties L-dopa (Caius, 1989; Pandey, 1999) and there is heavy demand for Mucuna in Indian drug markets. After the discovery that Mucuna seeds contain L-dopa, an anti-Parkinson's disease drug, its demand in international market has increased many folds (Faroogi, 1999) and the demand have motivated Indian farmers to start commercial cultivation.

Oudhia (2001), stated that the roots of Mucuna are bitter, thermogenic, diuretic, emollient, stimulant, aphrodisial, purgative, febrifuge and tonic. It is considered useful to relieve constipation, nephropathy, strangury, dysmenorohoea, amenorrhoea, elephantiasis, dropsy, neuropathy, consumption, ulcers, helminthiasis, fever and delirium (Lindley, 1985; Warrier, 1996; Shalini, 1997). Oudhia (2001) indicated that the leaves are popular potherbs and are used as a fodder crop. The leaves are useful in the treatment of ulcers, inflammation, cephalagia and general debility. The trichomes of pods contain mucunain and serotonin and as a result pod causes itching, blisters and dermatitis. The pods are also used as vegetable and the pod hairs (trichomes) are used as antihelmintic and the mixture of hairs with honey have been used as vermifuge i.e., a drug used for driving out worms out of the body of man or animal. Ointment, prepared with the hairs acts as a local stimulant and mild vesicant (Sastry and Kavathekar, 1990; Chandra, 1993). According to Rastogi and Mehrotra (1991) Singh *et al.* (1995), seeds of mucuna contain L-dopa (4-3, 4 dihydroxy, phenylalanine) glutathione, lecithin, garlic acid, glucoside, nicotine, prurienine and dark brown viscous oil and serve as source of minerals. Oudhia (2001) observed that apart from the medicinal properties, Mucuna fixes nitrogen and serve as a green manure and cover crop. Staking increases yield by 25% and reduces pest infestation, while flowering begins 45-50 days after sowing (Oudhia and Tripathi, 2001). Yields of 5000 kg ha^{-1} have been recorded from well managed irrigated crop having supports (Singh *et al*., 1995; Farooqi *et al*., 1999).

Lima bean (*Phaseolus lunatus*): The lima bean originated from Guatemala but recent evidence proved that the smaller seeded types originated in the Pacific foothills of Mexico while the larger white seeded types originated in Peru (Daisy, 1979; Van der Maeseen and Sadikin, 1989). These researchers indicated that both types spread from these areas throughout South and Central America, the USA and Southern Canada. According to Van der Maeseen and Sadikin (1989), the lima bean was taken from Brazil to Africa particularly in the Western and Central parts during the slave trade era.

The Lima bean belongs to the species of family leguminoseae and propagated by seed (Peace Corps, 1976; Daisy, 1979; Ustimenko-Bakumovsky, 1983; Van der Maeseen and Sadikin, 1989; Darbie *et al*., 1999). These reaschers explained that it is a perennial twining climber and a grassy polymorphic plant whose vegetative period fluctuates from 80-90 to 120-150 days and sometimes longer depending on the variety. In describing the seeds of various cultivars of *Phaseolus lunatus* L. Daisy (1979) reported that some researchers divided the Lima bean into two separate species. The large seeded types *Phaseolus limensis* and the smaller, baby Lima or sieva bean-*Phaseolus lunatus*, but added that however, there is considerable evidence in favour of placing both types in one single species, *Phaseolus lunatus*. In another instance, Mackie (1943) explained that the cultivated Limas belong to three traditional culti-groups, sieva, potato and big Lima. Liol *et al*. (1991) also reported the existence of a fourth culti-group called intermediate sieva-big Lima types. They noted that the storage protein of this group suggests that, it may be a result of selection for large seeds within the sieva group rather than the result of introgression between the two gene pools.

Vander Measeen and Sadikin (1989) reported that the lima bean has over 2,500 accessions available in CIAT (Centro International de Agricultural Tropical) collection at Cali (Columbia) with seeds coming mainly from South and Central America, West Africa, Madagascar and Burma. However, small banks are found in the United States, Brazil, Costa Rica and Nigeria (IITA, Ibadan). Lima bean is a warm season crop (Darbie *et al*., 1999).

Germination and emergence of the lima bean occur 4-10 days after planting and vegetative growth accelerate after one month. The flowers appear 35-70 days and pods ripe 80-120 days after sowing with short day length (Van der Maeseen and Sadikin, 1989). In climbing types flowering and fruiting may extend throughout the wet season and that the pollens and stigmas mature synchronously and in close proximity within the unopened bud favouring self-pollination. However, cross-pollination often occurs and 75-80% of the flowers bud and young pods are shed. Ustimenko-Bakumovsky (1983) reported that the lima bean is more sensitive to temperature conditions than the common bean (*Phaseolus vulgaris*) and that temperatures below 16-17°C and above 35°C are unfavourable for its growth. He further noted that the lima bean has a high salt resistance unlike the common bean and can be short day in its light requirement. NAS (1979) reported that recent experiments in Africa proved that some little known cultivars of Lima have extra ordinary high yields in a low land rainforest region. This region has a difficult environment in which to grow crops especially pulses because of the high heat and humidity that foster pests and diseases that suppress growth or kill plant outright. Lima bean plant itself is valuable for restoring soil fertility throughout its growth and sheds copious leaves, which decay and enrich the soil.

In crop improvement, David (1984) reported that most breeding research has focused on erect, non-vining, bushy types with strong stems and a self-standing ability. He reported that in the characteristics of the lima bean the vining varieties require a support crop or other forms of staking and that it tolerates wetter weather during growth but is sensitive to soil acidity. Baudoin (1982a) stated that in the framework of a lima bean improvement programme in the humid tropics, several evaluation trials were carried out with a collection including mainly African cultivated forms and that the result obtained clearly demonstrated the poor agronomic value of the bush types. Among the climbing materials, numerous introductions were selected for their high productivity and their resistance to diseases, including golden mosaic disease which is the major constraint to the intensification of this crop in the forest area. The study, further revealed that all the sources of resistance to disease were exclusively found within the culti-group Big lima, which must be integrated in the future breeding works although they appear not to be well adapted in the tropical ecological zone.

In another work, Baudoin (1982b) reported that crosses between the cultivated forms themselves and between the cultivated forms and their wild relatives showed from the first generations real potentialities for obtaining climbing cultivars better adapted to the ecological zone. The author maintained that genes of resistance to golden mosaic, found within the culti-group big Lima, not fitted to the region concerned can be incorporated into several elite lines of the culti-group sieva. Furthermore, the transfer of this character is not accompanied by too many unfavourable attributes, such as the lateness of flowering. He however, reported that although the hybrids with the wild form show a good vegetative vigor and high degree of fecundity, they were however, susceptible to golden mosaic.

Throughout the tropics, yields of dry seed are 200-600 kg ha^{-1} in intercropping and 1000-1500 kg ha^{-1} in sole cropping (Peace Corps, 1976; Van der Maeseen; Sadikin, 1989). The researchers reported that dry seed in pure stands might reach 2,000-2,500 kg ha^{-1} for climbing types. Yields in small-scale farms usually vary from about 400-1,500 kg ha^{-1} and that lower yield of 200-300 kg ha^{-1} has been obtained in India (Daisy, 1979). In Western Nigeria, under experimental conditions yields over of 300 kg ha^{-1} have been reported indicating potentials of the crop in the humid tropics. Furthermore, in the USA, yield of dry seed averaged between 3,400 to 4,500 kg ha^{-1} while yields of green lima bean grown for processing average about 2580 kg ha^{-1}. Soaking is helpful not only in cutting down the cooking time but also in starting a fermentation process, which enhances the food value of the B-vitamin contained in the beans.

Daisy (1979) and Van der Maeseen and Sadikin (1989), in their search for the uses of *Phaseolus lunatus* L, indicated that the tropical lima bean is cultivated for both its immature and dry seeds. They reported that the leaves and seeds are valued for the astringent qualities and consequently used as a diet for fever in traditional Asian medicine. The lima bean is grown as a short duration cover crop or for manure while the leaves and stems may also be turned into hay or silage for animal feed. According to Baudoin (1981) interspecific hybrids can considerably increase the genetic variability of the species and by this method obtain bush cultivars well fitted for intensive cultivation in the concerned ecological zone. The morphological characteristics of the wild forms and their high degree of resistance to diseases such as the golden mosaic disease obviously give many hopes. Also, the interspecific hybrids between *Phaseolus lunatus* and several wild species are characterized by their high nitrogen content and this can be accompanied in some hybrids by an increase in methionine and half the increase in cystine as compared to those of the cultivated parental species (Baudoin, 1983). The relative content of other amino acids are intermediate or equivalent to those of the two parental forms, showing that the genetic improvement of the amino-acid spectrum by interspecific hybridization is thus possible if selection pressure is maintained during the following generation.

NAS (1979) felt that the main obstacle to the use of tropical lima bean is the prevailing ignorance of their potential, range of adaptation and the tropical aspect of their cultivation and use. As with lesser known and underutilized plants, regional preferences and cooking methods pose a problem, since other pulses like cowpea (*Vigna unguiculata*), pigeon pea (*Cajanus cajan*) and mung bean (*Vigna radiata* L.) have longer traditions of use throughout the tropics. Compared with cow pea the lima bean has longer cooking time and this may be a serious drawback. Although limas are widely eaten, they are one of the few pulses that contain toxic amounts of cyanide producing glucoside. Some varieties of Lima beans have dangerous levels of hydrocyanic acid (HCN) in leaves, pods and seeds, but this can be dissipated by boiling and changing the cooking water (NAS, 1979; David, 1984). Plant components of lima bean contain a cynogenic glucoside, limamarin or phaseolunatin (Kakes, 1990) from which hydrogen cyanide may be released by hydrolysis mainly through the enzyme linamarase or B-glucosidase.

Variety selection should be based on several criteria Darbie *et al.* (1999) suggested although yield is a significant factor, it should not be the only criterion used for variety selection. For example, market acceptability; local environmental adaptability, disease resistance and quality are all equally important. To buttress multi-criteria concept, stem anthracnose (fungus) is the major disease in lima bean production and this disease can infect all aboveground portions of the plant. This fungus causes severe pod blight, attacks stems and leaves and often discolours the bloom; the entire plant can be killed when the main stem is girdled. Furthermore, several insect pests can attack lima beans, examples of which include the soybean hopper, corn earworm and several species of stink bugs.

African yam bean (*Sphenostylis sternocarpa*): African yam bean belongs to the family leguminoseae and sub family Papilionoideae. It originated in Ethiopia. Today, both wild and cultivated types occur in tropical Africa as far as Zimbabwe through West Africa from Guinea to Nigeria (NAS, 1979; Daisy, 1987). It is especially common and particularly grown in Cameroon, Cote d'Ivoire, Ghana, Nigeria and Togo (Porter, 1992; Daisy, 1987; NAS, 1979). It is grown for both edible seeds and its tubers (IPGRI-FAO, 2001) but NAS (1979) and Porter (1992) reported that the plant produces underground tubers that are used as food in some parts of Africa and they serve as organs of perenation in the wild. However, Daisy (1979) emphasized that the tuber is the main product of the African yam bean and that they are cooked and eaten in the same manner as potatoes. Furthermore, Ibeawuchi and Ofoh (2000) reported that field observation showed that some of the African yam bean did not develop tubers in the field. They explained that the crop establish slowly and could not compete effectively for growth resources with fast growing legume crops like cowpea. Although there are extensive references to the use of the tuberous roots of African yam bean as a source of carbohydrates in West Africa (NAS, 1979; Ezueh, 1984; Ene-Obong and Okoye, 1992; Porter, 1992) the seeds only are used as food in Ghana (FPGRI-FAO, 2001).

The African yam bean is a vigorous growing herbaceous vine that climbs and twines to heights of over 3 m and requires staking. It has trifoliate leaves and leaflets that may be up to 14 cm in length and 5 cm broad (IPGRI-FAO, 2001). Small-scale cultivation is practiced throughout tropical Africa and the plant is suited for lowland conditions though it can be grown at 1800 m above sea level. It tolerates climates ranging from savannah to rainforest vegetation provided there is a combination of adequate rainfall 1000 mm or more during the growing season (Daisy, 1987). African yam bean flowers profusely in 100-150 days, producing brightly coloured flowers, which may be pink, purple or greenish white (IPGRI-FAO, 2001). The slightly woody pods contain 20-30 seeds and are up to 30 cm long maturing within 170 days and the way of managing African yam bean has not deviated from the method employed traditionally by farmers in Africa where it is always found in mixed culture and only scattered in small plots (NAS, 1979). It is often planted along with yam and beans, using the same stakes as the yam for support.

CONCLUSION

The potentials of leguminous crops have not been fully exploited especially in the humid and sub humid tropics for sustainable crop production. Depending on the prevailing factors in a particular soil, legumes have great potentials to fix nitrogen in soils, across the tropical and subtropical regions of the world. Landrace legumes serve as feed and food for animals and man and have about 25-45% protein and enough quantity and quality starch to sustain life. Efforts should be geared towards discovering more landraces from the wild with a view to improving them and integrating them into our farming systems for sustained food and fibre production and food security objectives of governments across the globe. Farmers in tropical and sub tropical regions must be educated to understand the role and importance of landrace legumes in our agricultural systems.

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