Review of Literature on Perennial Peanut (*Arachis pintoi*) as Potential Cover Crop in the Tropics

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Keywords: benefits of A. pintoi, living mulch, cover crop, soil physical, chemical and biological properties

Abstract

The use of living mulch as a substitute of plastic mulch is increasing in the tropics and researchers have gradually shifted their attention to organic farming system. *Arachis pintoi* is perennial plant and a member of leguminosae family. *A. pintoi* have a lot of potential for use as living mulch in association with vegetable, trees, or grass (as a pasture) because of its ability to fix nitrogen from the atmosphere and the strength to grow under heavy shade. In this work, the benefit of *A. pintoi* as living mulch was studied to provide farmer and researcher with scientific information based on fact sheets, journals and text book.

INTRODUCTION

Declining agricultural productivity after years of intensive farming has been the major concern of tropical farmers in recent times. High input systems are now believed to be incapable of ensuring sustainability under tropical condition (Lavelle *et al.* In Badejo *et al.* 2002). Researcher on tropical agriculture have gradually shifted their attention to organic farming systems (Lampkin In Badejo *et al.* 2002), where inorganic agrochemicals are substituted with organic inputs. For example, the substitution of legume cover crops for chemical herbicide and inorganic fertilizers.

A. pintoi is a perennial, low growing, ground cover species. This plant is a member of leguminosae family which can fix nitrogen from the atmosphere. Based on several fact sheet, *A. pintoi* is one of the most promising multipurpose legume cover crops that could be used as: living mulch in no-till vegetable production fields and orchards, forage animal feeding and ornamental ground cover along highway ramps and sidewalks. The objective of this work was to provide farmer and researcher with scientific information about the benefits and limitations of *A. pintoi* as living mulch and as compost in the tropics.

MATERIAL AND METHODS

Literature of *A. pintoi* were collected from every available information source, such as fact sheet, journal, text book, articles accessed in the online library, and websites from 2000 to 2007. The literatures were grouped based on the benefits of A. *pintoi*.

RESULT AND DISCUSSION

Researchers have been observed *A. pintoi* from many aspects, such as distribution, botany, agronomical and environmental benefit, breeding, etc. Several aspects of it are explained in this paper.

A. pintoi distribution

A. pintoi have a wide range of distribution. According to Cook (1992), the distribution of *Pintoi* comprise Australia, Argentina, Australia, United States, and more recently to many countries in South East Asia, Central America and the Pacific. This wide range of distribution supported by *Pintoi has a* wide of ecological suitability (Tropical forages, 2007). It can be grown throughout the wet tropics and subtropics, and the upland tropics up to 1400 m above sea level.

A. pintoi description

Botany

Cook (1992), describe *A. pintoi* as a member of Leguminosae/fabaceae family, nitrogen fixing legume, which has common name perennial peanut, pinto peanut, forage peanut, wild peanut, thua lisong tao (Thai). The Origin of this plant was Central Brazil (Cook, 1992). *A. pintoi has* bright yellow flower and green tetra foliate leaves and maintain the height of the sward no more than 20 cm. Stoloniferous, perennial herb non twinning with the pods under the ground (Cook, 1992).

Commercial cultivars of *A. pintoi* have been released in Australia (Amarillo), Costa Rica (Mani Mejorador, Porvenir), Brazil, Colombia (Mani Forrajero Perenne) and Honduras (Pico Bonito) (Mannetje, 2007).

Ecology

A. pintoi can grow in sandy or clay soil (Cook, 1992). It tolerates high levels of Al and Mn but has low tolerance of salinity, tolerate flooding and can grow well under heavy (70-80%) shade (Cook, 1992; Mannetje 2007; Tropical Forages, 2007). *A, pintoi* can survive in areas with annual rainfall of 1,000 mm or less, but grows best with over 1,500 mm/yr, and survives dry seasons of 3-4 months (Cook, 1992; Mannetje 2007; Tropical Forages, 2007).

Establishment

A. pintoi can be established from stolon, cuttings or seed (Cook, 1992). Seed should be sown 2-6 cm deep at 10-15 kg seed in pod/ha, followed by rolling. If seed is not available, it is readily propagated from cuttings. The easiest and cheapest way to plant *A. pintoi* is from seed but *A. pintoi* mats take less time and management to get and established (Abdul-Baki, 2002).

Based on literature, there are several major strengths and limitations of *A. pintoi.* The limitation is in the establishment phase. Several limitations mentioned from literature are:

1. Expensive establishment (Wunscher *et al.* 2004)
2. Poor growth in drought condition (Neef 2004; Neef *et al.* 2004; Wunscher *et al.* 2004)
3. Slow establishment (Rivas and Holfman, 2000)
4. Poor germination (Rivas and Holfman, 2000)
5. Insect and pest competition (Neef 2004; Neef *et al.* 2004)
6. Weed competition (Neef 2004; Neef *et al.* 2004; Wunscher *et al.* 2004)

But once Pintoi is establish, usually the limitation is reduced. After the establishment phase some limitations are due to insect, pest and weed competition. *A. pintoi* need about 6-12 months to establish depending on site suitability, ecology and environment.

A. pintoi benefit

A. pintoi have a lot of benefits and strengths. Some of the major benefits are mentioned in this paper, such as:

1. It is excellent for soil conservation
2. It improves soil quality
3. It is a good source of compost
4. It promotes tree growth
5. It is a choice livestock feed
6. It could control diseases
7. It could suppress weed growth
8. It is a hardy ornamental plant
9. It is a good source of nectar for bees

Below are more comprehensive explanation of *A. pintoi* benefit.

Pintoi for soil conservation

Mainly, farmer and researcher use *A. pintoi* as living ground cover in vegetable production, fruit orchard, plantation or legume-grass associated pasture. According to Firth (2002), there are several attributes, for plant in order to suit ideal ground cover. There are percent ground cover in low and relatively high light, ability to cover soil quickly, persistence, low sward height, and have sufficient herbage mass for effective erosion control.

According to the literature gained for this study, some experiment conclude that *A. pintoi* have almost all the attributes to be ideal ground cover.

1. *A. pintoi* is very good to reduce erosion and run off (Sugahara *et al.* 2001; Zhiping *et al.* 2002; Huang *et al.* 2004; Doanh and Tuan 2004; Maswar *et al.* 2005)
2. Produces dense soil cover (Firth *et al.* 2002; Neef 2004; Neef *et al.* 2004)
3. High dry matter production (Addison 2003; Gallegos 2003; Espindola *et al.* 2005; Oelbermann *et al.* 2005)
4. Recover degraded areas (De Oliveira *et al.* 2003; Doanh and Tuan 2004)
5. Tolerant to shade (Addison 2003; Firth *et al.* 2002)
6. High nutritive value and low fiber content (Firth *et al.* 2002; Neef 2004)
7. Persistence (Perez *et al.* 2001;Firth *et al.* 2002)
8. Low sward height (Firth *et al.* 2002)
9. Faster nutrient cycling (De Oliveira *et al.* 2003)
10. Grow well in low fertility soil with minimal fertilizer, minimal irrigation and no pesticide (Bryan *et al. 2001)*

A. pintoi as living mulches to improve soil quality

Several soil quality improvement has been reported, integrating *A. pintoi* as living mulches in pasture, orchard or plantation showing good results. *In general, A. pintoi* improved soil fertility (Firth *et al.* 2002; Doanh and Tuan 2004; Wunscher *et al.* 2004).

A. pintoi improved soil physical properties, such as soil density, soil structure, soil moisture and porosity (Perez *et al.* 2001; Firth *et al.* 2002; Zhiping *et al.* 2002;

Huang *et al.* 2004; Maswar *et al.* 2005). Associated *A. pintoi* as living ground cover with grass or under the tree, help the soil to be more productive because *Á. Pintoi* function as a blanket for the soil, the herbage mass cover the soil and prevent it to loose to much water from evaporation, also the root biomass improve the porosity, density and structure of the soil.

A. pintoi improved soil chemical properties, like soil N, P, K and Ca (Perez *et al.* 2001; Firth *et al.* 2002; Zhiping *et al.* 2002; Duda *et al.* 2003; Doanh and Tuan 2004; Huang *et al.* 2004; Espindola *et al.* 2005). *A. pintoi* perform dense soil cover which can reduce erosion and leaching of some soil chemical properties and fixing Nitrogen from atmosphere thereby it can help improve nitrogen availability of the soil.

A. pintoi improved soil living properties, like greater micro fauna and source of organic matter (Perez *et al.* 2001; Badejo *et al.* 2002; lanes *et al.* 2003; Canellas *et al. 2004;* Huang *et al.* 2004; Maswar *et al.* 2005). Dense soil cover performed by *A. pintoi* help the soil to maintain the moisture of the soil, became suitable place for microfauna to live, also, *A. pintoi* role as organic matter source, the food for soil microfauna which degraded organic matter into inorganic properties.

A. Pintoi as a good compost source

A. pintoi not only improve soil quality when planted as living mulch. The residue of *A.* pintoi can also used as compost raw material. *A. pintoi* litter work out to increase bacterial population when added to grass litter (Oliveira *et al.* 2002). In wet period, the half-lives of decomposition in mixed litters and *A. pintoi* less than 50% of those of grass litter alone according to de Oliveira, (2003) and reduce by about 80% in mixed litter and 90% in legume litter (Oliveira, 2002). This was happened because of legume usually has faster rates of decomposition and greater release of nutrients (Thomas In Oliveira *et al.* 2002). C/N ratios of legume and legume+grass mixture significantly lower than grass litter. Decomposition constant value were increased probably influenced by the lower initial C/N ratio and the higher microbial activity found in this litter (Oliveira, 2002).

A. pintoi as livestock feed

Some literature showed mutual benefit of integrated legume-grass pasture:

1. *A. pintoi* as fodder, (Perez *et al.* 2001; Doanh and Tuan 2004; Maswar *et al.* 2006)
2. Improve forage quantity and quality (Wunscher *et al.* 2004; Villarreal *et al.* 2005)
3. Increase milk production, stocking and calving rate, and also increase cattle weight (Rivas and Holfman, 2000; Lara and Reategui, 2004; Lobo and Acuna, 2004; Lowe *et al.* 2003)

All the benefit happened because of higher nutrient content in *A.* pintoi compare with the nutrient content in grass alone and also higher biomass production in grass-legume pasture. As livestock fodder, associated *A. pintoi* give positive effect for the soil and the livestock.

A. pintoi for disease management

Some of literature recorded ability of *A. pintoi* to control disease. Lapointe (2003) in the research about the effect of *A. pintoi* to reduce root weevil in "Carrizo" citrus showed that *A. pintoi* do not have negative effect on Diaprepes abbreviatus (root weevil) or on feeding damage. The root mass of all citrus carrizo infested with D. abbreviatus was significantly reduced, but the carrizo root weight

was greater when grown with *A. pintoi* than other legume plants. This may lead to polyculture solution, Andow In Lapointe, (2003) showed that pest species were less abundant in polyculture compared with monoculture systems. While, Hilje and Stansly (2007) showed that *A. pintoi* reduced the number of incoming whitefly adults, delayed the onset of tomato yellow mottle virus and decreased disease severity, resulting in higher yields and profits, compared to the bare soil control. Dominguez *et al.* (1990) in his research in tomato plant with *A. pintoi* conclude that association between tomato and *A. pintoi* reduced root galling (caused by *Meloidogyne arabica*) by almost 50%.

A. pintoi as weed control

A. pintoi can control weeds (Rivas and Holman, 2000; Doanh and Tuan, 2004). High biomass production of *A. pintoi* suppress some species of weed growth. Severino and Christoffeleti (2004), reported that *A. pintoi* supressed guenia grass, hairy beggarsticks and the natural weed infestation in Avocado orchard. Zhiping *et al.* (2002) from China, indicated that greater biomass in intercropping cassava and *A. pintoi* associated with reduced weed growth when compared to cassava monocrop. But Isaac *et al.* (2006) indicated that in *Commelina diffusa* infestation, *A. pintoi* showed only little potential for weed management.

A. pintoi as ornamental plant

Abdul-Baki (2002) conduct a research to saw the suitability of *A. pintoi* cv. Amarillo and Accession No. IRFL 7154, as a roadside demonstration in Florida concluded that *A. pintoi* is suitable as an ornamental plant. Production cost is low, since supplementary heat and light are not needed, required almost no mowing and it reduced roadside planting maintenance also provided an aesthetically pleasing green ground cover with attractive yellow flowers. After establishment it rarely needed watering even under drought conditions

CONCLUSION

Result from the study of literature since 2000 until 2007 showed that *A. pintoi* is an excellent living mulch for the Tropics because it has almost all agronomy traits for excellent mulch. Based of the result of this study, it is recommended to grow *Pintoi* as living mulch in order to reduce the need of chemical fertilizer and herbicide, for sustainability of agriculture.

ACKNOWLEDGMENTS

Embassy of Indonesia is thanked for the financial support. SANREM Project and North Carolina A&T State University is thanked for scientific and logistical support.

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