PROPAGATION AND ESTABLISHMENT OF PERENNIAL PEANUTS FOR GROUND COVERS ALONG ROADSIDES AND HIGHWAY RAMPS

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Abstract. Some perennial peanut (Arachis pintoi) cultivars and accessions have the potential for use as ground covers along roadsides and highway ramps in regions with mild winters. They tolerate drought conditions, grow well in sandy and calcareous soils of low fertility, fix N, recycle nutrients, prevent soil erosion through a thick above-ground cover and an intensive root system, produce beautiful flowers, remain green all year round, and do not require any mowing or fertilizer. Availability of propagation material has been a limiting factor in expanding their use, especially on a large scale. We describe a practical method for producing two types of propagation material - rooted plugs and mats. We further describe the planting and establishment of Arachis pintoi, cv. ‘Amarillo’, and accession No. IRFL 7154 as a roadside demonstration in a residential area of North Miami, Fla. This demonstration provides evidence of the great potential and attractiveness of this species as a ground cover along roadsides and highway ramps in southern Florida. Rooted plugs are less costly to produce and transport than mats. On the other hand, it takes less time and management to get an established stand from mats than from rooted plugs.

The rhizomatous perennial peanut species Arachis glabrata Benth (Section Rhizomatases) and the stoloniferous species Arachis pintoi Kravockivs and W. C. Gregory (section Caulorrhizae) were introduced into Florida from Brazil in 1932 (Blickensdfer et al., 1964) and in 1968 (National Germplasm Resources on-line database, ARS/USDA), respectively. Following introduction, they have been evaluated extensively in Florida and the Gulf Coast region primarily for hay production (Blickensdfer et al., 1964; Prine, 1980; Reed and Ocumpaugh, 1991; Rich et al., 1995; Ruttinger, 1989; Valencia et al., 1999). The broad genetic base of the tested accessions made it possible to select for desirable traits such as high biomass production with elevated nutritive quality (French et al., 1994; Ruttinger, 1989), resistance to Meloidogyne arabiaca (Domínguez et al., 1990) and M. exigua (Vallejos, 1992) nematodes, shade tolerance (Cook et al., 1990), ability to fix nitrogen, recycle nutrients, reduce soil erosion, and add organic matter to the soil (Bryan et al., 2001). Arachis spp. require minimal management inputs once the stands are established (Argel, 1994; de la Cruz et al., 1994). The extensive work on the accessions resulted in the release of three cultivars of A. glabrata: ‘Arb’ in 1964 (Blickensdfer et al., 1964); ‘Florigraze’ in 1978 (Prine et al., 1981); and ‘Arbook’ in 1985 (Prine et al., 1986). Additionally, the A. pintoi cultivars, ‘Amarillo’ and ‘Porvenir’, were released in Australia in 1987 (Cook et al., 1990) and Latin America in 1997 (Argel and Villarreal, 1998), respectively. Progress in the use of Arachis spp in live-stock production has been reviewed for Latin America (Lascano, 1994; Pizarro and Rincon, 1994), Central America and Mexico (Argel, 1994), Asia, Africa and the Pacific (Stür and Ndkumana, 1994), and the United States (French et al., 1994; Sollenberger et al., 1989).

The Arachis spp. have several attractive traits that have not been adequately explored in the U.S. other than for forage production. On the other hand, A. pintoi has been used in many areas of Costa Rica and Columbia for the protection of steep roadside slopes and as an ornamental in home gardens and parks (Lascano, personal communication). For example, the prolific production, attractive flowers, and the ability to tolerate shaded environments while out-competing most weed species are important properties for cultivars/accessions to be grown in shaded parks and along roadsides. Good growth potential under shaded conditions is also important for use as ground covers in tree orchards. A. pintoi cv ‘Amarillo’ and IRFL 4222 have attractive flowers and grow well in shaded areas (Cook et al., 1990). The bright yellow flowers of ‘Amarillo’ and IRFL 7154 emerge above a dense green foliar mat, resulting in a more attractive ground cover than grass for roadsides and highway ramps. Additional advantages over grass ground covers include good growth potential on low fertility calcareous soils, an ability to fix their own nitrogen, drought tolerance, and, few requirements for mowing. This last property greatly reduces maintenance cost and makes the Arachis spp. a truly sustainable ground cover (Rouse and Mulalahey, 1997).

Three main factors have limited the expansion of perennial Arachis use: 1) inadequate sources of planting material (vegetative propagation requires about 7 m3 of plant material per ha), 2) inadequate mechanization to cut, dig and plant the propagules, and 3) slow establishment rates, which may take up to three years (Valentim et al., 1987). Some measure of weed control is usually required during the lengthy period of establishment. Planting perennial peanut with a nurse crop, such as buckwheat or alfalfa, has proven to be highly beneficial (Anonymous 2001).

Also, maintaining the nurse crop at a 5 to 8-cm stubble height reduces weed competition and stimulates lateral spreading of the Arachis stolons. Some of the herbicides that have been used successfully include the application of glyphosate ten days before planting A. pintoi stolons followed one month later with an application of Fluazifop-p-butyl or sethoxydim and light mowing at three months (de la Cruz et al., 1994; Dwyer et al., 1989; Kretschmer, personal communication). In addition, Rouse and Mulalahey (1997) reported effective grass control with Fluazifop-p-butyl, an important factor.

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in the establishment of the rhizoma peanut. Furthermore, M. J. Williams (personal communication) found that glyphosate provided selective weed suppression in rhizomatous perennial peanut cultivars.

We report on a practical procedure for large-scale production of rooted plugs using stolon cuttings from A. pintoi, cv. ‘Amarillo’ and IRFL 7154, and on subsequent production of mats from rooted plugs. We further describe the planting and establishment of a roadside demonstration plot in a residential area of north Miami, Fla., as evidence of the great potential and attractiveness of this species as a ground cover along roadsides and highway ramps in southern Florida.

Materials and Methods

Source of plant material for propagation. ‘Amarillo’ and IRFL 7154 were two of the 16 cultivars/accessions of perennial *Arachis* obtained from the collection of Prof. Albert E. Kretschmer, Jr., Indian River Research and Education Center, University of Florida, Ft. Pierce, Fla. They were planted on 3 Mar. 1997, at the Tropical Research and Education Center (TREC), University of Florida, Homestead, to serve as plant material sources for further research. Each cultivar/accession was planted in a 2.2 m x 9.5 m plot. Planting methods and subsequent management throughout the establishment period are described in Bryan et al., 2001. Unrooted stolons from ‘Amarillo’ and IRFL 7154 were the source of cuttings used in these experiments for establishing a propagation procedure for the production of rooted plugs and mats as well as for establishing a demonstration plot on a roadside of a residential area in North Miami. They were chosen because of their vigorous growth, rapid establishment, dark-green, thick foliage, and abundant yellow flowers (Kretschmer et al., 2001).

Production of rooted plugs. Stolon cuttings about 8 to 10 cm long (2 to 3 nodes), with or without leaves, were taken from 3-month old stolons (Fig. 1). Generally a single stolon provided two adequate cuttings. The cuttings were first treated with cowpea ‘EL’ Rhizobium inoculant at the rooting zone to stimulate root growth, and then planted in styrofoam trays containing Pro-Mix BX (Premier Horticulture Inc., Red Hill, PA 18076). Each tray contained 72 cells, (4.5 x 4.5 x 8 cm). Three cuttings were planted in each cell (Fig. 2). The propagation trays were placed under a partially shaded frame over a layer of plastic mulch to prevent root growth into the soil below. An automated mist system maintained adequate moisture during the propagation period. Stolons developed a prolific root system within 7 to 9 weeks and were ready to transplant into the beds. Rooting under these conditions was about 80% (Fig. 3).

Production of mats from rooted plugs. The system we developed to produce mats from rooted plugs consisted of a series of flat 3.2 m x 1.6 m beds with a 60-cm alleys between beds (Fig. 4). Iron rods (40-cm length, 2-cm diameter) were hammered into the limestone substrate at the 4 corners of each bed. The bed floor was leveled and a strong string was securely tied to the rods at a 10-cm height around the bed perimeter. Plastic mulch sheeting was laid within the bed, extending up and over the string to form sidewalls with excess sheeting tucked back under the floor plastic. Drainage was provided by several punctures to the plastic floor. This bed enclosure was then filled with compost (West Palm Beach in-vessel co-compost consisting by dry weight of 30% biosolids and 70% yard waste) to a depth of 9 cm, irrigated with an automated sprinkling system, and planted with six evenly spaced root plugs. The plastic floor and sides of the bed served two purposes: (1) they prevented weed propagules with the exception of nut-sedges - from below and to the sides from invading the compost, and (2) they prevented the peanut roots from...
penetrating into the gravely soil, which would have caused great damage to the roots upon removal of the mats.

The beds for production of mats were arranged in a randomized complete block design with three replications. Excellent establishment was achieved on all beds. The transplants grew rapidly and covered the whole bed area within 5 months. The stolons grew exponentially, branched profusely, and initiated new roots. However, the tendency of the surface of the compost to dry rapidly prevented rooting. Therefore a ca. 1.5 cm layer of topsoil was applied to the surface of the compost, and thereafter rooting occurred. The extensive network of roots and stolons held the bedding media in place. The new stolons resulted in a highly efficient stand capable of capturing solar radiation, fixing N, and producing attractive flowers (Bryan et al., 2001) (Fig. 5).

Weeds were controlled by means of herbicides supplemented with hand weeding. Cadre (imazapyc) provided excellent control of both purple and yellow nutsedges. Roundup was effective against many weed species, and Fluazifop-p-butyl was effective in killing grasses. Basagran (bentazon) damaged a significant percentage of dayflower plants, but this treatment did not eradicate this weed. However, a few days after the weed had been sprayed, it became very weak, and could be removed easily by hand. The weeds that appeared to be most resistant to selective chemical control were beggarsticks (Bidens spp.), prickly sida (Sida spinosa) and artilleryweed (Pilea microphylla).

‘Amarillo’ and IRFL 7154 exhibited mild iron deficiency during the cool, short winter days. Some foliage turned light green to pale yellow during the cool, short-day months when photosynthesis and new foliage formation were slow. The deficiency was corrected with one drenching of Sequestrene® 138Fe (Ciba Geigy, Greensboro, NC) at 5 kg-4000 L/ha one month following transplanting into the beds.

Once plant foliage achieved 100% bed coverage, the sturdy network of stolons and roots was ready for harvest. The perennial peanut mats could be removed and used as propagation material. A grass edger was used to cut through the thick stoloniferous mat and plastic floor. The plastic was included in the roll to assure maximum retention of the composts and rootlets. The 3.6 x 1.6-m bed was cut lengthwise into five 3.2 x 0.3-m strips. These strips were then cut in half. Thus one bed generated ten 1.6 x 0.3-m mats. This convenient mat dimension can be easily rolled and carried by one person (Fig. 6). The 1.6 x 0.3-m mat comprised the standard propagation and transport unit for large-scale planting at target sites. During shipment and handling, these rolled mats held adequate amounts of water for several days. At the planting site, the mat was unrolled, further divided into forty 15 x 7 cm pieces, and these pieces were then planted at 70-cm within-row and 70-cm between row spacings. Watering and weed control were critically important during the first 6 weeks following planting to ensure successful establishment.

A successful roadside demonstration. A demonstration plot was initiated to compare ‘Amarillo’ and IRFL 7154 with grass as ground covers along a roadside. The location was a center median strip (9.1-m long x 2.3-m wide) that had already been planted into grass, at the entrance of a residential area at NW 102nd Avenue, 40 m south of NW 52nd Street, Miami, Florida (Fig. 7). Prior to this demonstration the grass received extensive management inputs including frequent watering, routine mowing, fertilization and herbicide application for weed con-
The objective of this demonstration was to show how perennial peanut could both reduce roadside planting maintenance and provide an aesthetically pleasing green ground cover with attractive yellow flowers. Clearly, these factors make perennial peanut a favorable alternative to grass for roadside landscaping. Participants in this demonstration plot were the United States Department of Agriculture/Agricultural Research Service (represented by the senior author), the University of Florida Tropical Research and Education Center, Homestead (represented by the junior authors), Miami-Dade County Parks Department, South Florida Resource Conservation and Development Council, and South Dade Soil and Water Conservation District.

One part of the strip (3.1-m long) was planted to ‘Amarillo’; the rest (6.0-m long) was planted into IRFL 7154. This accession performed well in our nursery at Homestead, and had excellent traits for use at roadsides similar to ‘Amarillo’. The grass was scraped to a depth of 10 cm, the soil was loosened, and then mixed with compost to provide good contact between the mat roots and the underlying soil. Using the previously described rolled mats, the perennial peanut was planted as a 90-cm wide strip along the center of the median with roughly 60-cm wide unplanted borders on either side. The transplanted mats were pressed tight to encourage good contact between the emergent roots and the underlying soil-compost mixture. Additional compost was spread over the mats and watered to cover the roots and keep them moist. During the first few weeks after planting, the perennial peanut plants received the same watering regime that was being applied to the grassy landscaping. Following planting on 28 Nov. 2000 until full establishment, the plot was mowed only once, and received no fertilizer and no other inputs other than water. In fact, the perennial peanut planting received much more water than necessary, since the irrigation regime was still targeted for the surrounding grass-based landscaping. Within one year, the plot was fully established, providing an aesthetically attractive alternative to the traditional weed-infested grass stands typifying residential roadside median strips. Under perennial peanut, overall management costs were also reduced, since mowing and fertilizer inputs were not required.

Results and Discussion

The large-scale expansion of perennial peanut use in south Florida is severely constrained by the limited supply of propagation material. To address this constraint, strategies must be developed that will allow for the efficient vegetative production of rooted propagules on small and large scales. We were inspired to develop these propagation methods because it is very difficult to harvest seed or intact roots in the Krome gravelly loam soil in Miami-Dade County. However, since many *Arachis* species produce seed, for those with access to sandy soil it may be cheaper to produce seed than rooted plugs or mats for propagation (A. E. Kretschmer, Jr., pers. comm.).

Our approach describes two options for the production of rooted propagules, rooted plugs and stolon mats. Both options are suitable for long-distance transport and marketing, without risk of drying or any other damage that would reduce the quality and survival of the planting material. Once established, the small plastic lined beds serve as a source of propagation material. Cuttings for rooted plug production can be made at any time during the year. Trays for rooted plugs should have a cell size of 5 x 5 x 7 cm in order to maintain sufficient moisture for the development of a strong root system. Production cost is low since, in the subtropical climate of south Florida, supplementary heat and light are not needed. Only a partially shaded area and an automated sprinkler system are needed.

Mat production is more costly and takes longer time to prepare. Though the proposed flat beds for mat production are simple to build, management requirements are higher, including irrigation, weed control, and harvest. Shipping mats is more costly than shipping plugs on a hectare basis. On the other hand, mats provide extensive rooting material for large-scale planting. Furthermore, the stand gets established faster, and competition by weeds is significantly less relative to stand establishment efforts with rooted plugs alone.

One advantage of *A. pintoi* over *A. glabrata* is that it produces seed. However, the technical and economical feasibilities of propagating it by seed to protect roadsides have not been explored. To our knowledge, the potential use of perennial peanuts along roadsides and highway ramps in the U.S. has not been explored with *A. pintoi* despite the availability of cultivars, and accessions that have the desirable traits. Perennial peanuts offer many advantages over grass as ground cover. Once established, the extensive root system and thick foliage cover of perennial peanut prevents soil erosion even on the steep slopes that are typically encountered with highway ramps. Perennial peanuts have greatly reduced fertilizer requirements, since they fix nitrogen, and can efficiently re-
cycle nutrients by storing essential nutrients in their large stoloniferous biomass (Bryan et al., 2001). These low growing legumes require almost no mowing and watering is rarely needed even under drought conditions. Above all, the perennial peanut performs well in low fertility calcareous soils and can tolerate heavy traffic and wheel pressure by landscaping equipment. These properties collectively reduce management costs, which ultimately make perennial peanut a sustainable ground cover with almost no maintenance requirements.

In contrast to the low maintenance cost of perennial peanut, maintenance cost of grass along roadways is high. In the year 2000-2001, Florida Department of Transportation spent 17.9 million dollars on mowing 297,010 ha of roadways (Table 1). An additional 0.56 million dollars was spent on fertilizer. This brings the mowing and fertilizer cost to an average of $62.15 per ha per year. It should be noted that the maintenance cost of sloped areas ($260.63 per ha) is about 6.9 times more than that of flat, open areas that utilize large-size mowers. Use of perennial peanut on these sloped ramps would significantly reduce maintenance costs.

On the aesthetic side, many perennial peanut accessions/cultivars such as ‘Amarillo’ and IRFL 7154 routinely produce a prolific and attractive stand of yellow flowers set against a pleasing green background that persists year-round (Figs. 4 and 5). In an established stand, the leaf surface area routinely exceeds the soil surface area by a factor of 15 or more. This high-density biomass efficiently captures light energy, which, in turn, is used to produce organic matter food reserves for the plant. Over time the high-N leaf litter will serve to enrich the sandy or calcareous soils prevalent in south Florida.

The demonstration plot established in north Miami highlights an important niche that can be successfully addressed by A. pintoi perennial peanuts, namely, sustainable, low-maintenance attractive landscaping for use on roadways and highway ramps. Currently there are millions of hectares of park areas, roadways and highway ramps throughout the southern and Gulf Coast USA that can be planted to this ground cover. Replacing these currently grass/weed-based systems with perennial peanut will effectively reduce maintenance costs. It also would save the Parks Services and the Highways Administrations millions of dollars, and would provide the local populace a more aesthetically pleasing landscape on roadways and highway ramps. Reproducibility of establishment was substantiated in a separate study (data not shown) initiated in Aug. 2001 in which the two accessions were established between trees in five rows in an Annona grove at TREC. The latter experiment is a randomized complete block with five replications. Good establishment has been achieved in all the plots. In summary, this paper presents two strategies for the efficient propagation of perennial peanut plant material, that can be enlisted to improve the often neglected and unsightly appearance of public roadways and highway ramps.

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Source: J. Allen and K. McCray, Department of Transportation, Florida

Table 1. Roadside mowing cost for the state of Florida during the year 2000-2001.


National Germplasm Resources Laboratory on-line database, Germplasm Resources Information Network, ARS, USDA, Beltsville, MD indicates that Arachis pintoi was first received in Nov. 1968 as P. I. 338314 from a collection in Cruz das Almas, Brazil.


RATING LANDSCAPE TREES: LESSONS LEARNED FROM AN EXPERT SURVEY

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Abstract. The monetary value of landscape trees is needed for various purposes including tree inventories, real estate transactions, lawsuits, insurance claims, tax purposes, and tree care investment decisions. Several formulas and methods have been developed to determine these values. The most widely used method, the trunk formula method, requires a species rating value for the tree being appraised. Pooling judgments and opinions of tree experts, such as foresters, horticulturists, landscape architects, nurserymen and arborists, is a widely used procedure to derive species rating value. Due to differences in training and background of tree professionals, and the wide variability of landscapes in any given area, professional agreement on the rating of a species is difficult to reach, but yet, necessary to be useful. This study describes our experiences in developing species rating values for Louisiana trees using the traditional technique of pooling expert opinions and the associated difficulties and problems others might encounter going through a similar undertaking in Florida. This study also examines the degree of agreement among the professional groups in the rating of species listed for Louisiana by the International Society Arboriculture (ISA).

Trees have become widely recognized as important component of urbanized and developing landscapes. Urban landscape trees are also called amenity trees because they produce a variety of tangible and intangible benefits for urban dwellers and have monetary value. The need to know the monetary value of landscape trees is no longer limited to real estate transactions, lawsuits, insurance claims, tax purposes but also for tree inventories and tree care investment decisions.

The most common and widely used method for establishing the value of large trees is through the use of formulas. In the United States, several formulas and methods of determining the monetary value of landscape trees have been developed over the years. These formulas and methods are described in the 8th edition of the Guide for Plant Appraisal by the Council of Tree and Landscape Appraisers (CTLA). These formulas are each a function of four primary factors, namely, size, species, condition and location factors. The most widely used of these formulas is the trunk formula method for trees too large to be physically replaceable. Using the formula requires the determination of a species rating value based solely upon species characteristics. Watson (2000) compared the trunk formula method with other formulas, and concluded that the major differences in appraised values using the trunk formula are attributed to species rating value.

Tree appraisers, arborists, foresters, and other plant professionals have been using species values that came with the Guide. These species rating values were subjectively assigned by a group of experts in 1970 (Lewis, 1970). The current species rating values are in five categories of 20% class intervals. The Guide classifies trees according to species and varieties, varying according to different geographical areas in the country.

The problem with the system of species rating by pooling experts is that it gives a wide range of values to every species. This translates to very divergent appraisals by two or more plant/tree professionals of a tree in question. Experiment sta-