Research Note

WINGED BEANS AS A POTENTIAL FOOD AND GREEN MANURE CROP UNDER CONDITIONS IN PUERTO RICO[1]

The winged bean (*Psophocarpus tetragonolobus*) is still a little known tropical multipurpose legume which might have an unexpected potential in home gardening due to the high protein content of edible leaves, pods, seeds and roots. It can also be valuable as a green manure crop because of the high amounts of N that it can fix biologically for its own use and for transfer to succeeding crops in rotation. It is well known that winged beans can form numerous and rather large N-fixing root nodules.[2,3] The winged bean is widely grown in Papua New Guinea, Malaya, the Philippine Islands and other areas. An unusual interest in this legume crop has been aroused since 1975, when its great potential was recognized.[4]

The plant is a climbing herbaceous perennial which can grow up to 3.05 or 3.66 m high if provided adequate support. Leaves are trifoliate; the blue or white flowers are of the papilionaceous type. Pods, 10 to 30 cm in length, are 4-sided with characteristic serrated wings running down the four edges.[5] There are 10 to 16 seeds/pod.[6] Seeds range from nearly globular[7] to almost conical[6] and are white, yellow, brown or black.[7] Roots thicken after a few months.

The purpose of this study was to assess the potential of winged beans as a food crop to be grown under home garden conditions and as a green manure crop under more extensive conditions in Puerto Rico.

A winged bean selection obtained by Martin and Delpin[8] was planted at the beginning of April at a site in the pineapple region near Manati on the north coast and in mid-May at the Corozal Substation in the northern hilly mountain region, at 23 cm within the row with an interior spacing

[1] Manuscript submitted to Editorial Board October 15, 1979.

[2] Harding, J., Lugo-López, M. A., and Pérez-Escolar, R., Promiscuous root nodulation of winged beans on an Oxisol in Puerto Rico, Trop. Agr. 55 (4):315–24, 1978.

[3] Masefield, G. B., Root nodulation and agricultural potential of the leguminous genus Psophocarpus, Trop. Agr. 38:225, 1961.

[4] New York Academy of Sciences, The winged bean, a high-protein crop for the tropics, 1975.

[5] Masefield, G. B., *Psophocarpus tetragonolobus* - A crop with a future? Field Crop Abstr. 26 (4):157–60, 1973.

[6] Thompstone, E., and Swayer, A. M., The peas and beans of Burma, Burma Agri. Dep. Bull. 12:83, 1914.

[7] Pursglove, J. W., Tropical crops, Dicotyledons, London; Longmans, Green and Co. Ltd., 1968.

[8] Martin, F. W. and Delpin, H., Vegetables for the hot, humid tropics, I. The winged bean, *Psophocarpus tetragonolobus*, ARS, USDA, January 1978.

of 61 cm. Weeds were removed manually. Excellent crop protection from insects and diseases was achieved through the preventive biweekly use of Sevin[9] and Dithane at rates of 1.40 and 1.68 kg/ha, respectively. Sprinkler irrigation was used as necessary. The crops at both sites received a blanket application at planting time of 112 kg/ha of P_2O_5 as triple superphosphate, 112 kg/ha of K_2O as sulfate, and 56 kg/ha of Mg as sulfate. Due to the indeterminate nature of the crop, harvest time began in mid August and extended through early October at Manati, and from mid September to the end of October at Corozal.

The experiments followed complete block designs with six replications at each site. At Manati, the soil was a Bayamón (Typic Haplorthox, sandy loam on the surface and clayey underneath, oxidic, isohyperthermic). At Corozal, the soil was a Humatas (Typic Tropohumults, clayey, kaolinitic, isohyperthermic).[10] Details as to soil properties, exposure and elevation are given elsewhere.[11]

Yields of winged beans at both sites were as follows:

Soil and site	*Grain*		*Stover*
		Kg/ha	
Oxisol at Manatí	1,456	(dry grain)	2,733
Ultisol at Corozal	2,800	(green pod)	2,240

Yields of this magnitude compare well with those obtained at other locations[4] and also with yields of mungbeans,[12] pigeonpeas,[13] fieldbeans[14] and other legumes. These are substantial yields of high-protein grains and pods for relatively short periods of only 6 to 7 months. Stover yields compare very well with those obtained from mungbeans and soybeans at the same locations.[11]

Crop management appears to be a key factor in winged bean production. Data from Del Valle et al.[15] under conditions at Cidra in Central

[9] Trade names in this publication are used only to provide specific information. Mention of a trade name does not constitute a warranty of equipment or materials by the Agricultural Experiment Station of the University of Puerto Rico, nor is this mention a statement of preference over other equipment or materials.

[10] Lugo-López, M. A., and Rivera, L. H., Updated taxonomic classification of the soils of Puerto Rico, Agri. Exp. Stn. Bull. Univ. P.R. 258, 1978.

[11] Lugo-López, M. A., Scott, T. W., and Pérez-Escolar, R., Value of crop residues for soil protection and as sources of N in Oxisols and Ultisols, Paper presented at the Tropical Soils Workshop, Kingston, Jamaica, June 1978.

[12] Lugo-López, M. A. and Pérez-Escolar, R., Mungbeans, (*Vigna radiata* var. *aureus*): A versatile crop with potential under conditions in Puerto Rico. Submitted for publication.

[13] Lugo-López, M. A., High yields of non-fertilized protein-rich pigeonpeas on tropical soils of low inherent fertility of Puerto Rico: An explanation to a paradox, J. Agri. Univ. P.R. 65(1): , 1981.

[14] Lugo-López, M. A., Badillo-Faliciano, J., and Calduch, L., Response of native white beans (*Phaseolus vulgaris*) to various N levels on an Oxisol, J. Agri. Univ. P.R. 61(4):438–42, 1977.

[15] Del Valle, R. and Lugo-López, M. A., 1980. Effect of wire supports vs. no supports on fresh pod yield of two winged bean cultivars, J. Agri. Univ. P.R. 64(2):211–8.

Puerto Rico can be summarized as follows:

Treatment	*Green pod yields, t/ha*
Trellised	7.3
Untrellised	4.2

Protein content of edible roots was around 15%.

Crude protein values reported by Kahn and Claydon[16] are as follows:

Edible portion	*Crude protein, %* (N × 6.25)
Ripe seed	36.6
Root tubers	10.9
Foliage	5.7
Flowers	5.6

Non-protein N in seeds and roots is of the order of 3.4 and 1.1%, respectively. Protein content of the seeds is higher than that reported for soybeans, peanuts and cowpeas. These data point to the significance of winged beans as a food crop. It can be easily produced in the home garden. Root tubers can be harvested some 7 to 8 months after planting. At harvesting, they are usually a little thicker than the thumb.

Pérez-Escolar et al.[17] report that in rotation at Manatí, corn yields increased from 2337 kg/ha of corn following corn to 3096 kg/ha of corn following winged beans; in rotation at Corozal corn yield was 4716 kg/ha when following corn, but 4658 kg/ha when following winged beans.

The sandy Oxisol at Manatí benefited from the applications of winged-bean green manure while no such benefits were measurable at the clayey Ultisol at Corozal. The amount of added N in the stover plowed under was determined by the Kjeldahl technique.[18] The results can be summarized as follows: at the Manatí Oxisol, 30 kg/ha; at the Corozal Ultisol, 28 kg/ha.

Differences are negligible. Therefore, the explanation as to the differential response to green manure additions on these soils must be sought elsewhere, possibly in the fact that some residual fertilizer N was still available for the second corn crop in the sequence. In any case, the yields of corn are rather high and compare well with those reported by Sotomayor,[19] and Badillo-Feliciano et al.[20] It is remarkable that those yields

[16] Kahn, T. N. and Claydon, A., Role of induced mutation in the improvement of a potential new source of protein-winged bean (*Psophocarpus tetragonolobus*) Univ. Papua, New Guinea, Mimeog, Paper.

[17] Pérez-Escolar, R., Scott, T. W., and Lugo-López, M. A., Legume and non-legume crop residues as sources of N in Oxisols and Ultisols, J. Agri. Univ. P.R. 62(4):361–6, 1978.

[18] Black, C. A. (Ed), Methods of soil analysis, Am. Soc. Agron., Wis. Monogr. 9, 1965.

[19] Sotomayor-Ríos, A., Performance of twelve corn hybrids and selections in three consecutive crops on the same site in the same year, J. Agri. Univ. P.R. 63(2):170–9, 1979.

[20] Badillo-Feliciano, J., Lugo-López, M. A., and Scott, T. W., Influence of cultivars, N levels and time of N application on plant characters, leaf composition and yield of corn grown on an Oxisol, J. Agri. Univ. P.R. 63(3):273–80, 1979.

were obtained without the application of fertilizer N in the legume green manure plots, while the original corn crop received fertilizer N at the rate of 67 kg/ha.

According to Burkill[21] and Thompstone and Swayer[6] a crop of sugarcane preceded by one of winged beans yields 50% more than usual under conditions in Burma. Pospisil et al.[22] also indicate the value of this legume in crop rotations.

Promiscuous nodulation of winged beans under conditions on an Oxisol in northwestern Puerto Rico has been reported by Harding et al.[2] Nodules were larger and more numerous than those of pigeon peas, cowpeas and beans (*Phaseolus* sp.). This unusual degree of root nodulation has been also observed by other investigators.[3]

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[22] Pospisil, F., Karikasi, S. K., and Boamah-Mensah, E., Investigations of winged bean in Ghana, World Crops, pp. 260–4, Sept. Oct. 1971.