



## MULTI-PURPOSE SPECIES IN THE KUXUR RUM AGROFORESTRY SYSTEM ON THE DRY CORRIDOR AREA, GUATEMALA

### ESPECIES MULTIUSO EN EL SISTEMA AGROFORESTAL DEL KUXUR RUM EN LA ZONA DEL CORREDOR SECO, GUATEMALA

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#### ABSTRACT

Agriculture in Guatemala is the main economic activity, nonetheless 51% of the population lives in poverty and has diet limitations. A research has been done in the area of the dry corridor, nearby the cities of Jocotán and Camotán (*Ch'Orti' area*, from the former Maya civilization), characterized by high temperatures and seasonal rainfall with periodical long droughts. Subsistence agriculture practice by the farmers is dependent on rainfall. The harsh weather is faced also with the "Kuxur Rum" agroforestry system based on *Gliricidia sepium* (Jacq.) Walp. in rows and intercropped food grains. Our research focused on native species in the under layer of the Kuxur Rum agroforestry system, and their traditional use by the Ch'Orti' population. Although most of the under-layer vegetation is considered weeds, many of these native species are harvested by farmers for food or medicinal purposes. Data were collected during September-December 2019, through structured questionnaires and quantitative analysis of the botanical composition, comparing areas with the agroforestry system and others. The Kuxur rum has provided good conditions for many plant species, thus should be considered also a technique useful to help on the conservation of ancient knowledge of plant uses. This research has been possible thanks to the collaboration of the University of Florence (Italy), Cunori of the San Carlos University of Guatemala and the Italian NGO "Mani Tese".

**Keywords:** Kuxur Rum, traditional techniques, droughts, subsistence agriculture, botanical composition

#### RESUMEN

La agricultura es la principal actividad económica en Guatemala, sin embargo el 51% de la población vive en pobreza y tiene limitaciones alimentarias. Se realizó una investigación en el área del corredor seco, cerca de las ciudades de Jocotán y Camotán (área Ch'Orti', de la antigua civilización maya), caracterizada por altas temperaturas y lluvias estacionales con largas sequías periódicas. La práctica de la agricultura de subsistencia por parte de los agricultores depende de las lluvias. El clima severo también se enfrenta al sistema agroforestal "Kuxur Rum" basado en *Gliricidia sepium* (Jacq.) Walp. en hileras y granos alimenticios intercalados. Nuestra investigación se centró en las especies nativas en el estrato inferior del sistema agroforestal Kuxur Rum y su uso tradicional por la población Ch'Orti'. Aunque la mayor parte de la vegetación del estrato inferior se considera maleza, muchas de estas especies nativas son cosechadas por los agricultores con fines alimentarios o medicinales. Los datos se recolectaron durante septiembre-diciembre de 2019, mediante cuestionarios estructurados y análisis cuantitativos de la composición botánica, comparando áreas con el sistema agroforestal y otros. El Kuxur Rum ha proporcionado buenas condiciones para muchas especies de plantas, por lo que también debe considerarse una técnica útil para ayudar a la conservación del conocimiento antiguo sobre los usos de las plantas. Esta investigación ha sido posible gracias a la colaboración de la Universidad de Florencia (Italia), Cunori de la Universidad de San Carlos de Guatemala y la ONG italiana "Mani Tese".

**Palabras clave:** Kuxur Rum, técnicas tradicionales, sequía, agricultura de subsistencia, composición botánica

Received: 13/2/2023

Accepted: 11/3/2023

**Conflict of interest:** There is not conflict of interest among the authors.



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## INTRODUCTION

The geographic area of the dry corridor in Guatemala is highly affected by weather extremes with unpredictable changes in terms of rainfall and temperature (Quesada-Hernández et al., 2019). Drought periods during summer started to become longer, reducing the crop season (Petroni & Preti, 2010). Farmers are now cropping species and cultivars with shorter cycles of growth and, consequently, less yielding.

The negative effects due to unpredictable weather are faced with the “Kuxur Rum” agroforestry system, a word than in the local language Ch'Ortí' means “My wet soil”, and suggests the convenience of maintaining humidity inside the soil for a long time. Even when this is not covered by plants, and enables continuing incorporation of organic matter into the upper layers of soil. Some research has proven also the positive effect of the Kuxur Rum agroforestry system into the fight to soil erosion (Posada Quinteros, 2012).

The Kuxur Rum agroforestry system is based on the planting of Madrecacao trees (*Gliricidia sepium* (Jacq.) Walp.) in rows intercropped with grains like *Phaseolus vulgaris* L. and *Zea mays* (L.). Every year, before the sowing of the crops, the Madrecacao trees are strongly pruned or even coppiced, leaving the residues grounded as mulching above the soil. The use of *Gliricidia sepium* is because as a leguminous species native from Central America has a high level of adaptability to the environment, and thanks to this, it is commonly used by farmers as a living fence, or as fodder for livestock (mostly leaves).

Although research has been done on the effects of the Kuxur Rum agroforestry system on intercrop productivity and soil fertility (Villafuerte Lemus & Morales Calderón, 2019), not much is known about its effects on the biodiversity of plant species. Experience has shown that even increasing crop productivity as much as possible with the Kuxur Rum, this is not enough to improve farmer's wealth, and at the same time, many of the species present on the KR have also unknown medicinal properties that can be useful to next generations.

The objective of this research was to measure and quantify the plant biodiversity in the Kuxur Rum agroforestry system, compared to the most popular crop in Guatemala (*Milpas*, cornfields based on rotations).

## MATERIALS AND METHODS

The research has been done in the dry corridor area, in September - December 2019, and has investigated the biodiversity present inside the Kuxur Rum system and

compared with the plant species present on the *Milpas* (cornfields), moreover, we asked about the traditional uses of the plants known by the farmers and in the literature reviewed.

We compared two different kinds of treatments: 9 Kuxur + 9 *Milpas*. All plots shared similar ecological conditions, climate, altitude, slope, aspect, kind of soil and cropping history. The cornfields analyzed were selected near the areas with the KR agroforestry system. The botanical composition of every plot was investigated by linear analysis, 100 m long and with identification points at 50 cm of distance.

The plant uses referred by local farmers were investigated by semi-structured interviews, moreover, moreover farmers were asked about the productivity and management of the agroforestry system. All plant species were identified at the Cunori facilities, with Latin scientific name according to the “*The plant list Index*”, a working list of all known vascular plant species.

To know the use of medicinal plant species and plant parts, open interviews were done to farmers and local people. Afterward, two rural communities of the Dry corridor area (“*Dos quebradas*” and “*Lantinquin*” villages, both in the municipality of Camotan) were visited with the technicians of the NGO “*Santiago de Jocotan*”, (partner of *Mani tese*, Italia). Many interviews about medicinal uses of plants were done to women from the rural communities, during the interviews, plant samples or photographs were shown for identification (Thomas et al., 2007).

This research has been possible thanks to the collaboration of the University of Florence (Italy), Cunori of the San Carlos University (Guatemala), the NGO “*Mani Tese*” (Italy) and their partner in Guatemala, the NGO “*Santiago de Jocotan*”.

## RESULTS AND DISCUSSION

The total number of plant species (Table 1) has been higher inside the KR (55) than on the cornfields (42), probably, because most of the identified species are small weeds and, on the agroforestry, system have the advantage of less competition than in the traditional management of the land.

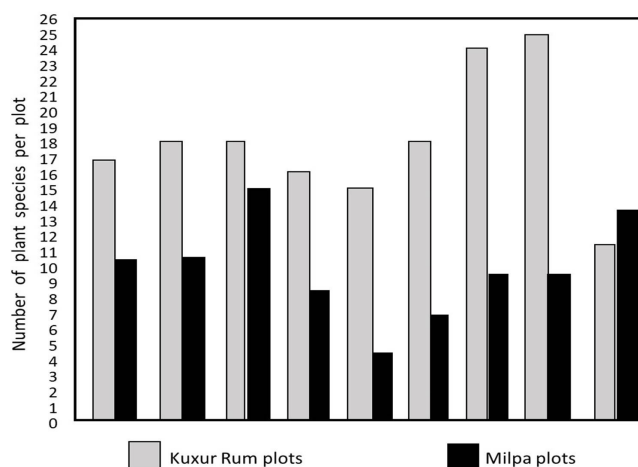
Moreover, the average number of species per plot (Figure 1) has been higher in Kuxur Rum (18.3) than outside (10.0). This suggests than the reduced presence of tree species (like *Mangifera indica* or *Gliricidia sepium*) or tree-like plants (ex: *Carica papaya* or *Musa x paradisiaca bananas*) favours the fertility of the soil and reduces the need of chemical weeding, thus permitting the existence of small native plants. Even if many of these trees or tree-like species were found on both different land treatments, they are present in different proportions and sizes.

Multi-purpose species in the Kuxur Rum agroforestry system on the dry corridor area, Guatemala

**Table 1.** List of plant species found in KR or Milpa areas, and their referred uses (F = Food, Fo = Forage, M = Medicine, Fe = Green Fence, In = Industry, W = Wood)

List of species	All plots		Uses referred
	KR	Milpa	
<i>Acacia hindsii</i> Benth.		X	Fo W
<i>Agave sisalana</i> Perrine	X		F In
<i>Aloe vera</i> (L.) Burm.f.		X	M In
<i>Amaranthus retroflexus</i> L.		X	M F
<i>Ambrosia peruviana</i> Willd.		X	M
<i>Ananas comosus</i> (L.) Merr.	X		F
<i>Annona cherimola</i> Mill.	X		F
<i>Bromelia karatas</i> L.		X	F M Fe
<i>Byrsonima crassifolia</i> (L.) Kunth		X	F M
<i>Caesalpinia velutina</i> (Britton & Rose) Standl.		X	Fo Fe W
<i>Cajanus cajan</i> (L.) Millsp.	X	X	F Fo
<i>Calliandra houstoniana</i> (Mill.) Standl.		X	M
<i>Canavalia ensiformis</i> (L.) DC.	X		F
<i>Capsicum annum</i> L.	X		F M In
<i>Carica papaya</i> L.	X		F M
<i>Casimiroa edulis</i> La Llave		X	F Fo M W
<i>Cedrela odorata</i> L.	X	X	M W In
<i>Cenchrus echinatus</i> L.	X		
<i>Chamaedorea tepejilote</i> Liebm.	X		F
<i>Citrus limon</i> (L.) Osbeck	X	X	F M
<i>Coffea arabica</i> L.	X		F
<i>Colocasia esculenta</i> (L.) Schott		X	F
<i>Cordia alba</i> (Jacq.) Roem. & Schult.		X	F W
<i>Cnidioscolus aconitifolius</i> (Mill.) I.M.Johnst.	X		F M
<i>Crescentia alata</i> Kunth	X		F M Fe In W
<i>Crotalaria longirostrata</i> Hook. & Arn.	X		F M
<i>Cucurbita argyrosperma</i> (C.) Huber	X	X	F
<i>Cyperus odoratus</i> L.	X		
<i>Echinochloa colona</i> (L.) Link	X		
<i>Eucalyptus camaldulensis</i> Dehnh.	X		M W
<i>Euphorbia hirta</i> L.	X		
<i>Euphorbia heterophylla</i> L.	X		
<i>Fernaldia pandurata</i> (A.DC.) Woodson	X		F M
<i>Gliricidia sepium</i> (Jacq.) Walp.	X	X	F Fo Fe W
<i>Guazuma ulmifolia</i> Lam.		X	Fo M W
<i>Haematoxylum campechianum</i> L.		X	M W
<i>Ipomoea batatas</i> (L.) Lam.	X		F Fo
<i>Ipomoea lacunosa</i> L.	X		F
<i>Karwinskia calderonii</i> Standl.		X	Fo
<i>Lysiloma aurita</i> (Schltdl.) Benth.		X	In Fe W
<i>Manihot esculenta</i> Crantz	X		F
<i>Mangifera indica</i> L.	X	X	F
<i>Manilkara zapota</i> (L.) P.Royen		X	F M In
<i>Melampodium divaricatum</i> (Rich. ex Rich.) DC.	X		
<i>Mentha spicata</i> L.		X	F M
<i>Mimosa pudica</i> L.	X		M
<i>Moringa oleifera</i> Lam.	X		F M Fo W
<i>Musa x paradisiaca</i>	X	X	F
<i>Neurolaena lobata</i> (L.) R.Br. ex Cass.		X	M
<i>Parthenium hysterophorus</i> L.		X	M

List of species	All plots		Uses referred
	KR	Milpa	
<i>Persea americana</i> Mill.	X	X	F M
<i>Persicaria amphibia</i> (L.) Delarbre		X	
<i>Phaseolus vulgaris</i> L.	X		F
<i>Pinus oocarpa</i> Schiede	X	X	M W
<i>Pluchea carolinensis</i> (Jacq.) D.Don	X	X	M
<i>Pouteria sapota</i> (Jacq.) H.E.Moore & Stearn		X	F
<i>Psidium guajava</i> L.	X	X	F M Fo W
<i>Quercus peduncularis</i> Nee		X	M Fo W
<i>Rauvolfia tetraphylla</i> L.	X		M
<i>Richardia scabra</i> L.	X		
<i>Rottboellia cochinchinensis</i> (Lour.) Clayton	X		
<i>Ruta graveolens</i> L.	X	X	M
<i>Sabal mexicana</i> Mart.	X	X	F Fe In
<i>Saccharum officinarum</i> L.	X		F In
<i>Schizolobium parahyba</i> (Vell.) S.F.Blake	X	X	Fe
<i>Sechium edule</i> (Jacq.) Sw.	X		F M
<i>Sida acuta</i> Burm.f.	X		
<i>Solanum lycopersicum</i> L.	X		F
<i>Solanum americanum</i> Mill.	X	X	F M Fo
<i>Solanum torvum</i> Sw.		X	M In
<i>Sorghum bicolor</i> (L.) Moench	X		F Fo
<i>Spondias purpurea</i> L.	X	X	F M
<i>Tagetes erecta</i> L.		X	R M
<i>Tecoma stans</i> (L.) Juss. ex Kunth		X	M W
<i>Trianthema portulacastrum</i> L.	X		M
<i>Tridax procumbens</i> (L.) L.	X		M
<i>Verbena officinalis</i> L.		X	M
<i>Vigna unguiculata</i> (L.) Walp.	X		F Fo
<i>Cynodon dactylon</i> (L.) Pers	X		
<i>Zea mays</i> L.	X		F
<i>Zingiber officinale</i> Roscoe	X		F M
<i>Total</i>	55	42	



**Figure 1.** Number of plant species per each plot inside the Kuxur rum agroforestry system (grey) and inside the *Milpas*, cornfields (black).

## CONCLUSIONS

The findings of this study show that the Kuxur Rum agroforestry system has increased the tree canopy cover, sparse enough to allow the growth of an herbal under layer. Although the lower spontaneous plants are popularly considered weeds, most of them have interesting uses on traditional medicine, partially or still not yet investigated by science.

The common cornfields (*Milpas*), with frequent ecological control of these weeds (mostly with chemicals, but also with manual control) keeps their presence controlled, and on the other hand, permits their subsistence.

In turn, the controlled conditions of the Kuxur Rum provide a better environment for the survival of small-sized herbs, which most of them produce useful secondary metabolites. We conclude that the Kuxur Rum agroforestry system provides not only a useful crop differentiation and better soil conservation but also better conditions for the conservation of the biodiversity in terms of plant species than in the traditional *Milpas*, thus the agroforestry system should be considered also useful on the conservation of traditional knowledge of plant uses.

## ACKNOWLEDGEMENTS

This research project has been run thanks to the contribution of many persons, among them we would like to special thanks the collaboration of Prof. Federico Preti and Ph.D. Giulio Castelli from the University of Florence; Prof. Angel Urzua, Prof. Ricardo Suchini Paiz and Prof. Hugo Villafuerte from the San Carlos University of Guatemala (Cunori); And especially, to the technicians from the NGO Santiago de Jocotan (Guatemala): Sergio Sagastume and Rocio Zalazar; and Claudia Zaninelli of the NGO Mani Tese (Italy). The research group would like to deeply thanks to the farmers/informants and their families, that have been

involved in this research project, who generously shared their knowledge.

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