Water Manipulation:
A Key to Power in Prehispanic Palmarejo?

Derek Lincoln
Honors Thesis

Honors College, University of South Florida

Thesis Director: Dr. E. Christian Wells
Thesis Committee: Dr. Karla L. Davis-Salazar

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Abstract

This thesis examines the relationship between water and power in prehispanic Honduras. Research was largely based on the excavations and surveys done in 2006 by the USF archaeological field school and also past excavations of other sites in the area. The site excavated was Palmarejo and is part of a larger project conducted by Dr. E. Christian Wells and Dr. Karla Davis-Salazar. Past excavations have suggested that the site of Palmarejo (main focus of 2006 field work) was politically superior to various sites around it. This thesis discusses a potential explanation for this, hypothesizing that it was due to the manipulation of water supplies. This thesis explains how the collection and storage of water was a viable method of political dominance. Soil cores taken from the area, including a depression at Palmarejo, were analyzed to determine whether or not Palmarejo practiced this method of water control. The soil analyses reveal that the residents may have employed this technique.

Acknowledgements

The Palmarejo Community Archaeological Project, directed by E. Christian Wells, Karla L. Davis-Salazar, and Jose E. Moreno-Cortes, is funded by the National Geographic Society, the Foundation for the Advancement of Mesoamerican Studies, and various granting agencies at the University of South Florida, including the Office of Research and Scholarship, the Office of Undergraduate Research, the Institute for the Study of Latin America and the Caribbean, and the Patel Center for Global Solutions.

Theoretical Framework

Since the beginnings of civilization, people have built their settlements next to an abundant source of water. The ancient cultures of Mesopotamia relied on the Tigris and Euphrates rivers, while the Egyptians thrived due to the Nile. Throughout history, access to water has been a key factor in selecting locations for settlements. No group has been able to rise to power without a readily available source of water, such as a major river or lake system, for both drinking and irrigation. If there was no major natural water supply, civilization would cease, unless some other source was created. This was the case in ancient Mesoamerica, where numerous civilizations were able to thrive including the Maya.

The lush and tropical jungles of Central America give a misleading conception of the region's resources. That they are well watered throughout the year as other rainforests are is an ill-founded statement. The Southern Maya Lowlands (Northern Guatemala to Western Honduras) receive up to 80 inches of rain a year (Scarborough 1992) but this statement can be misleading, as all this rainfall comes in an eight-month period (May-December). The remainder of the year presents the inhabitants with a drought (Scarborough 1992). Despite being confronted by seasonal periods with no water, the Maya were responsible for the great cities of Tikal, Palenque, and Copan. The ability of the Maya to thrive is by no means an indication of water having a reduced role in the culture. Water had the utmost importance to the ancient Maya, not only for drinking and watering the crops but in buildings materials as well. Also, the staple crop was maize, which required intensive irrigation to yield a successful harvest, and is a strong testament to the extreme reliance Maya civilization had on water. How, then, was the culture able to survive and construct some of the largest urban centers in the world at that time in a region that had a four month period of no rain?

The precariousness of maintaining a water supply throughout the dry months gives insight into Maya political structures. The Maya's ability to ensure a supply of water during the dry season relied not on an abundant source, but rather effective management of the limited supply that did exist. Water management, according to Scarborough (1991:101), consists of "the interruption and redirection of the natural movement or collection of water by society." Since water was such a scarce resource, and yet so critical to survival, effective management techniques employed by Maya elite allowed them to politically manipulate water to centralize their power and control (Davis-Salazar 2003; Scarborough 1998). The first and necessary step in this process included the collection and storage of water (Scarborough and Gallopin 1991). The water was collected and stored in reservoirs, bajos, and lagoons. This collection was relatively easy for the Maya elite as they did not have to modify the landscape but could rely on the naturally sloping terrain to cause the rainwater to runoff into the depressions (Davis-Salazar 2003). Studies on the locations of these reservoirs and bajos have revealed that they were indeed *the* major source of this crucial resource during the four month drought (Scarborough and Gallopin 1991). The long annual drought that affected the region as well as the lack of permanent and adequate water sources meant the reservoirs and bajos gave the elite owners of the reservoirs and bajos absolute control over this scarce and vital resource. This control resulted in great political leverage (Scarborough and Gallopin 1991). Certainly there were other factors that affected power and authority, such as the use of monumental architecture and luxury goods, the skill and ability of rulers, and also warfare (Scarborough 1998), however the organizing and political power of water control in an otherwise lacking environment cannot be over emphasized. Maya rulers were extremely capable and successful at controlling and manipulating this resource and thus achieved their power (Scarborough 1992). The elite figures could exert pressures upon people since they decided when to allocate and distribute the water. Water indeed was a key to power, and those who had it could exert their influence and control over the surrounding populations and communities who did not.

The Study Area

The work completed for this thesis was done in and around the Palmarejo Archaeological Zone, which is situated in the Naco Valley, Honduras. The valley is formed by the Sierra do Omoa Mountains on either side, in the Northwest part of the country. It is outside San Pedro Sula, the second largest metropolis in modern day Honduras. The valley is bisected by the Chamelecon River. However, the average annual rainfall is only half that of regional averages outside the valley, at 1300 mm/year (Anderson 1992). While this rain creates small streams and quebradas during the wet season to feed the Chamelecon, during the four month drought they disappear and no longer inflate the river. Thus, the inhabitants were presented with the hydration crises mentioned above, characteristic of the whole region.

Archaeological work in the valley began in the 1980s consisting of survey and excavation. Research in the Palmarejo Archaeological Zone is currently undertaken by the Palmarejo Community Archaeological Project. The current work being done, from which the samples and research for this paper come, is directed by E. Christian Wells, Karla L. Davis-Salazar and Jose E. Moreno-Cortes.

The Naco Valley has yielded a wealth of archaeological material from nearly 400 sites which existed between 1000 BC and the 16th century AD, with most being established in the Classic period (250-900 AD). In the Palmarejo Archaeological Zone, the area of concern for this thesis, survey has confirmed the presence of 96 different sites of varying size. Through analysis of the surface collections that surveys have yielded, Wells has concluded that every site was occupied primarily during the Late Classic Period (AD 600-900). The collection of sites has been divided into five communities. These include, Palmarejo, Palos Blancos, El Morro, Suyapa, and Pacayal (fig. 1). Each of these sites is located near a quebrada but, as mentioned above, none of these quebradas exist in the dry season. The largest of these communities was Palmarejo, containing 93 buildings. According to Davis-Salazar, 28 of the buildings were monumental platforms with dressed stone architecture and may have had religious or political functions (Davis-Salazar et. al. 2005). Monumental architecture by definition consists of stone faced platforms of at least 1.5 meters high and signifies political importance. The abundance of monumental architecture was quite surprising and interesting when excavations first revealed its presence. It also gives insight into the power distribution of the area. The time, resources, and labor involved in constructing monumental architecture are quite extensive and it can be said that the presence of it in a community is indicative of economic prosperity. The presence of 28 such structures at Palmarejo suggests that it did, indeed, enjoy this prosperity. This luxury and prominence they had could only result from their political dominance over the surrounding region. The economic power and political control they exercised raises the question of how they were able to achieve this influence over the other communities.

Geomorphological study and survey of the area reveal the presence of various depressions dotting the landscape. Interestingly, there is a large depression, possibly a bajo, at Palmarejo. If the Palmarejo residents exploited this feature in the ways mentioned above they would have been able to collect water during the wet season and in turn, manipulate their supply during the drought to leverage political and economic power. Thus, in light of Palmarejo's apparent supremacy and prestige in the region, it is hypothesized that this bajo was used to collect and manipulate water for political purposes.

Methods

To test the hypothesis that the bajo was used to hold water during the settlement period of Palmarejo (Late Classic), laboratory analyses were done on soil samples taken from the depression, as well as other similar nearby features. The soil samples were collected under supervision of David Keuhn, the geoarchaeologist working on the project. Four auger probes were excavated at the location of the depression and one at a nearby quebrada near a lagoon. Three of the probes from the possible bajo were taken in the actual depression and the fourth was excavated just outside it. Auger probe #1 was excavated in the center of the depression to a depth of 0.70 meters where bedrock was hit. Auger probe #2 was located 5 meters to the north of probe #1 and hit bedrock at 0.77 meters. The third probe (Auger #3) was excavated 2.50 meters west of probe #1 and reached a depth of 0.99 meters. All three probes revealed soil profiles containing three horizons. The horizons in all three were identified as A, Bt and Bg (Keuhn, 2007). The A horizon is described as follows:

The A horizon is the uppermost mineral layer. It may lie below the O horizon. An A horizon has a high concentration of humus and is not dominated by the margin of clay, humus, aluminum, or iron into or out of the horizon. The humus content gives it a darker color than the horizon below.

The Bt Horizon

Indicates an accumulation of silicate clay that has either formed and subsequently been translocated within the horizon or has been moved into the horizon by illuviation, or both. At least some part of the horizon should show evidence of clay accumulation either as coatings on surfaces of peds in pores, or as lamellae or bridges between mineral grains.

The Bg Horizon

Indicates either that iron has been reduced and removed during soil formation, or that saturation with stagnant water has preserved it in a reduced state. Most of the effected layers have a chroma of 2 or less, and many have redox concentrations. The low chroma can represent either the color of uncoated sand and silt particles from which the iron has been removed. The symbol G is not used for materials of low chroma that have no history of wetness, such as some shales or E horizons. If g is used with B, pedogenic change in addition to gleying is implied. The horizon is designated Cg if no other pedogenic change has occurred. (Reed et. al. 2000)

The presence of the Bg horizon identified by the geoarchaeologist is suggestive of the soil being exposed to a prolonged still water environment. While this observation already lends support to the hypothesis that the depression served to collect and store water, further analysis and evidence is necessary to evaluate this idea. The soil samples taken were imported from Honduras for further examination in the USF archaeology soil lab.

Tests were also done on samples taken from small depressions in other areas of the valley as well. These depressions are not thought to have held water year round, as the other communities were not as well established as Palmarejo. One profile was extracted from the Palos Blancos area (revealing 3 horizons), one from Palmarito (revealing 5 horizons), and two from El Morro (revealing 4 horizons each). None of these profiles were identified as having a Bg horizon by the geoarchaeologist, however these samples have been analyzed in the lab as well.

There are numerous tests that could be indicative of prolonged saturation in a still water environment. The most telling experiment would be to test for iron, as low amounts would be a very good indicator of the soil having existed in a ponded environment. Unfortunately the iron test requires very expensive equipment, which was not available for this research. However, various other methods can suggest a submerged environment for the soil in prehispanic times. These include color analysis, pH tests, texture analysis, and nutrient concentration tests for nutrients such as phosphorus (P), nitrogen (N), and Potassium (K).

Each sample (A-Bt-BG horizons of each probe = 12 samples, and two horizons in the quebrada probe = 14), was labeled A-1 through A-14. The horizons from the four probes excavated elsewhere in the region were labeled B-1 through B-16. A standard Munsell color guide was used to determine the color of each sample. A LaMotte soil testing kit was used to determine the pH of each sample, and also the PNK values of the samples. This was done by a simple process of adding an extraction agent to each sample, filtering the solution, then adding a reagent to measure the amount of each element in the sample. The texture analysis was done to determine the amount of sand, silt, and clay in each sample. A texture dispersing agent was added to each sample and the solution poured off to separate the sand, then the process was repeated to extract the clay from the silt. (Results found in appendix A).

Specific numbers regarding PNK levels in the samples would not yield much insight into the soil's environment over a millennium ago; however, changes in numbers and trends down the profile can be very useful. The A horizon is a much younger layer of soil and thus the horizons further down would have been the ones exposed to the water if it indeed filled the bajo. If there was water, the soil would be expected to be grayer in color further down the profile (Huddleston et. al. 1996). This would be indicative of an anaerobic environment where the soil is reduced. "Under prolonged anaerobic conditions, iron is chemically reduced to compounds that have low-chroma (gray, gray-green) colors - in other words gleyed. The presence of gray colors is often used as a criterion for identifying wetland soils." (Keuhn 2007). The ph is expected to increase slightly down the profile as prolonged exposure to water should result in the soil being slightly alkaline. Phosphate and Nitrogen amounts should also increase down the profile, as higher levels of these nutrients would be indicative of the organic life one would expect to find in a ponded environment. Also, under prolonged subaqueous environments, soil would be expected to have increased clay content and decreased sand content (Reed et. al. 2000). The presence of clay also helps reduce water drainage, thus increasing the storage capacity. Therefore the soils, especially at the lower horizons, should be composed of relatively high amounts of clay.

Results and Discussion

According to the Munsell color guide, all three probes taken inside the depression contained grey colored soils at the lower horizons. This is consistent with water once covering the soil. The pH tests revealed a slightly alkaline state for each of the samples, with probes #2 and #3 becoming more basic down the profile as hypothesized. Phosphate levels increased towards the Bg horizon, which was also established as a possible criteria for water exposure. Probes #1 and #3 also revealed high levels of phosphate in the A horizon; however, modern day fertilizers contain phosphate and this may have contaminated the upper level of soil. Unfortunately the nitrogen tests revealed very random results, from shifting levels in probe #1 to almost none in the lower two horizons of probes #2 and #4. Nitrogen is a very mobile nutrient in soil, very susceptible to leaching, and so it is unlikely that the levels now have anything to do with the levels that may have existed at the bottom of a late first millennium AD pond. The texture analysis was more supportive of the original hypothesis. While all the lower horizons have a fair amount of clay, the high amounts in probe 1 and 3 are strongly indicative of wetland environments.

While some of the samples' test results do not support my original hypothesis, many of the patterns were found. Based on characteristics such as the color of the soil, the increasing phosphate amounts, the high clay content, the alkaline nature of the soil, and the Bg horizon, it can be inferred that the Palmarejo bajo once contained standing water for a long period.

The samples from Palos Blancos contained no gray colors and there was no Bg horizon. This means that the soils were not gleyed or reduced, which are both criteria for the soil having been exposed to water for a long period of time. Also, only the bottom horizon is slightly basic, the others being neutral or acidic. There are low amounts of phosphorus throughout the profile, which are not suggestive of the organics an aqueous environment would support. It is unlikely that Palos Blancos collected a supply of water here.

The Palmarito samples analysis yielded similar results. The Profile again lacks a Bg horizon and gray colors in the soils, which indicates the soil was not reduced. Also, the phosphorus greatly decreases down the profile. It is unlikely that the residents here had a constant supply of water either.

The two profiles from El Morro also indicated that reduction did not occur in these soils. Also, the soils are quite acidic. While the first profile has increasing phosphate amounts, it has extremely low amounts of clay and lacks any other evidence of a still water environment. The second profile has decreasing phosphorus and clay levels. The El Morro samples yielded even more compelling results to suggest the lack of a water supply for the residents here than the other two areas.

This means that the residents of Palmarejo were the only ones who collected water in the bajo. The lack of other water storage in the region may mean that the Palmarejo residents were aware of their ability to exploit the landscape and manipulate this scarce resource to their advantage.

Conclusions

One of the most important resources in Northwestern Honduras in the Late Classic Period was water; it was also one of the scarcest for a third of the year. Maya rulers were extremely capable of using this scarcity and its resulting implication to their advantage. Following suit, the elite of Palmarejo also may have been able to do this. The result was the ability of Palmarejo to achieve political and economic advantage in the region. By controlling this vital resource, they may have been able to subjugate the surrounding communities. This in turn would have allowed them the time and resources to build monumental architecture as well as consume and use other luxury goods. There are certainly other factors aside from water control involved in bringing a region to prominence, such as good diplomacy and rulership, as well as other important environmental issues such as the agricultural capacity of the soil (Verdaasdonk 2007). However, these other factors would not come into play without a source of water first. The minerals conducive for high crop yields and the agricultural capacity of the earth would not matter if there was no water for irrigation, and no one would have the opportunity to lead for long if they could not first supply their people with water. Thus, the Palmarejo community is an excellent example that shows how water was a power in the Late Classic Period.

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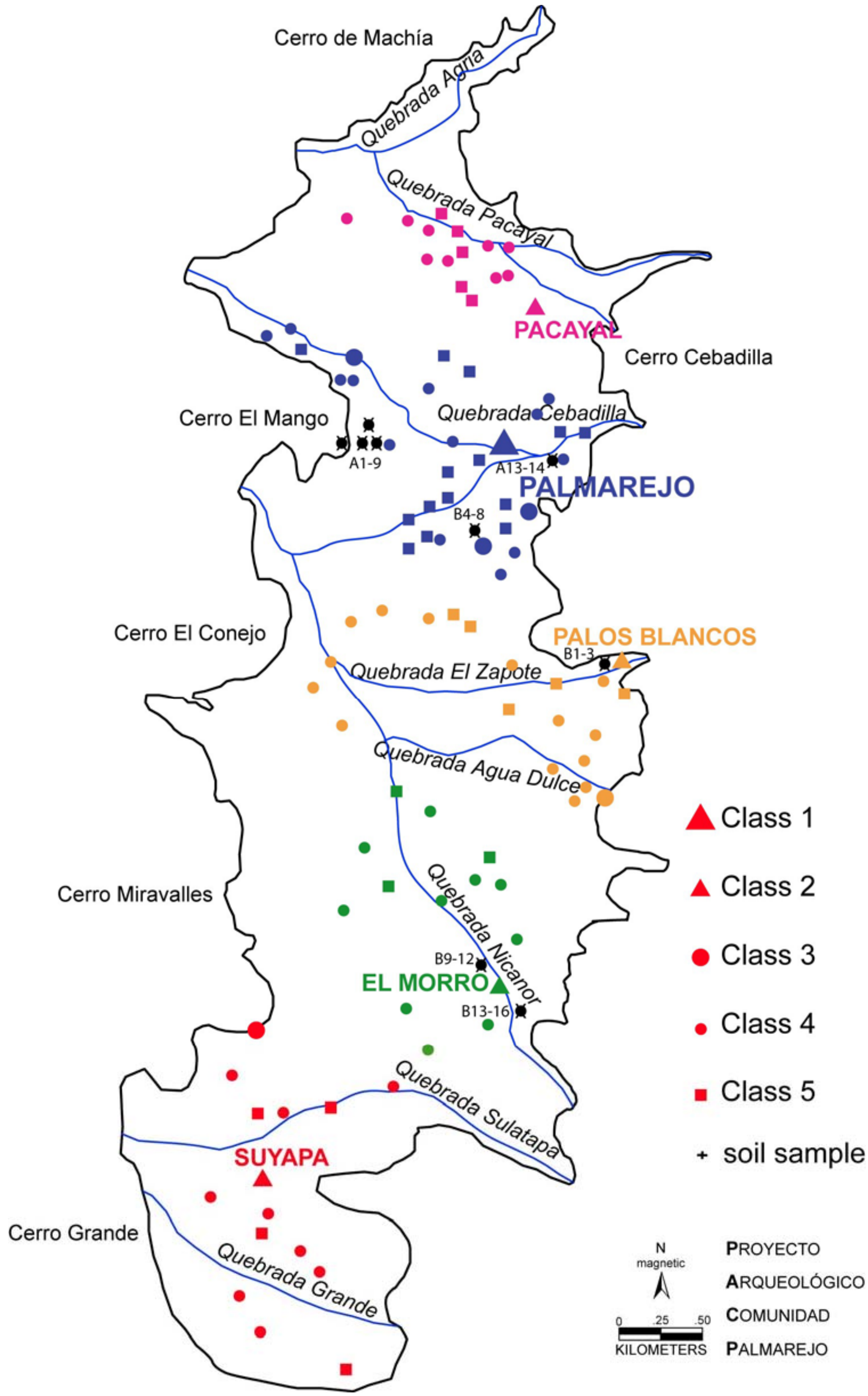


Figure 1. Map of the Palmarejo Archaeological Zone showing soil sample loci.

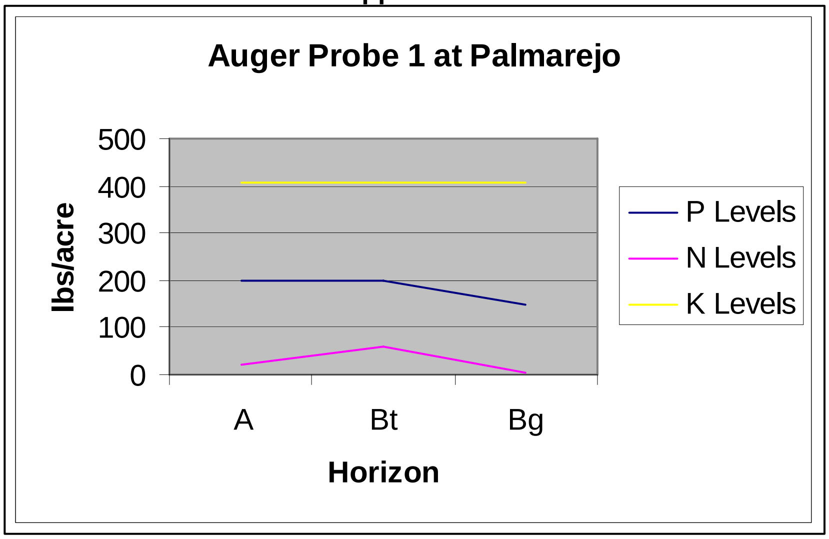
Appendix A: Laboratory Results

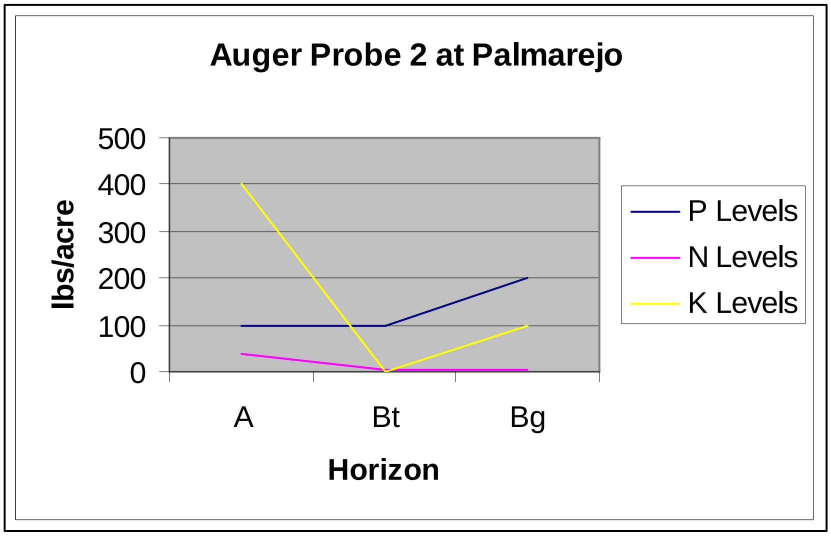
Code	Location	Auger Probe	Horizon	Munsell	Color	pH	P	N
A-1	El bajo-Mango	1	A	10YR 3/1	very dark gray	7.5	200	20
A-2	El bajo-Mango	1	BT	2.5Y 3/1	very dark gray	8	200	60
A-3	El bajo-Mango	1	BG	2.5Y 3/2	very dark grayish brown	7.5	150	<10
A-4	El bajo-Mango	2	A	2.5Y 3/1	very dark gray	7.5	100	40
A-5	El bajo-Mango	2	BT	2.5Y 3/1	very dark gray	7.5	100	<10
A-6	El bajo-Mango	2	BG	2.5Y 3/2	very dark grayish brown	8	200	<10
A-7	El bajo-Mango	3	A	10YR 2/1	black	7.5	200	40
A-8	El bajo-Mango	3	BT	10YR 2/1	black	7.5-8	100	20
A-9	El bajo-Mango	3	BG	2.5Y 3/2	very dark grayish brown	7.5-8	200	<10
A-10	El bajo-Mango	4	A	10YR 3/2	very dark grayish brown	7.5	150	20-40
A-11	El bajo-Mango	4	BT	2.5Y 7/4	pale yellow	7.5	150	<10
A-12	El bajo-Mango	4	BG	2.5Y 6/4	light yellowish brown	7.5	200	<10
A-13	Quebrada near Laguna	1	A	10YR 2/2	very dark brown	8	100	20
A-14	Quebrada near Laguna	1	BW	10YR 2/2	very dark brown	8	100	20
B-1	Palos Blancos	1	A	10YR 2/2	very dark brown	6.5	25	20
B-2	Palos Blancos	1	2BT	10YR 3/4	dark yellowish brown	7	25	10
B-3	Palos Blancos	1	2BW	10YR 3/3	dark brown	7.5	75	<10
B-4	Palmarito area	1	A	10YR 2/2	very dark brown	7	200	<10
B-5	Palmarito area	1	AB	10YR 3/2	very dark grayish brown	7.5	100	<10
B-6	Palmarito area	1	BW	2.5Y 4/3	olive brown	7.5	150	<10
B-7	Palmarito area	1	BK1	2.5Y 6/4	light yellowish brown	8	150	<10
B-8	Palmarito area	1	BK2	10YR 7/6	yellow	8	75	<10
B-9	El Morro area: Fan/T1	2	A	10YR 2/2	very dark brown	6	25	150
B-10	El Morro area: Fan/T1	2	BTB	2.5Y 4/2	dark grayish brown	7	25	10
B-11	El Morro area: Fan/T1	2	BW	10YR 3/4	dark yellowish brown	7	150	10
B-12	El Morro area: Fan/T1	2	BT1	10YR 3/3	dark brown	7.5	150	10
B-13	El Morro area: Fan/T1	3	A	10YR 2/1	black	6	100	>150
B-14	El Morro area: Fan/T1	3	A	2.5Y 3/1	very dark gray	6	50	125
B-15	El Morro area: Fan/T1	3	BW/BT	10YR 4/4	dark yellowish brown	6	25	20
B-16	El Morro area: Fan/T1	3	BT	10YR 3/3	dark brown	6.5	15	10

Appendix A: Laboratory Results (continued)

Code	K	Sand	Slit	Clay	Soil Type	Depth	Location
A-1	>400	60	6.6	33.3	sandy clay loam	0-40	center of depression
A-2	>400	60	6.6	33.3	sandy clay loam	40-50	
A-3	>400	40	26.6	33.3	clay loam	50-70	
A-4	>400	53.3	6.6	40	sandy clay	0-20	5 m N of AP1
A-5	0	66.6	6.6	27	sandy clay loam	20-30	
A-6	100	66.6	13.3	20	sandy loam	30-77	
A-7	>400	60	13	27	sandy clay loam	0-20	5 m W of AP1
A-8	>400	60	13	27	sandy clay loam	20-50	
A-9	100	46.6	6.6	46.6	sandy clay	50-99	
A-10	400	46.6	6.6	46.6	sandy clay	0-20	center of depression
A-11	100	40	20	40	clay loam	20-60	
A-12	140	53	26.6	20	sandy loam	60-108	
A-13	220-300	66.6	13	20	sandy loam	0-25	15.21.026 88.06.623
A-14	180	73.3	13	13	sandy loam	25-49	
B-1	>400	73	17	10	sandy loam	0-35	15.20.326 88.06.818
B-2	180	47	27	26	loam	35-70	
B-3	100	50	17	33	sandy clay loam	70-87	
B-4	>400	63	17	21	sandy clay loam	0-60	15.20.771 88.06.940
B-5	400	50	20	30	sandy clay loam	60-90	
B-6	>400	70	10	20	sandy loam	90-130	
B-7	>400	70	13	17	sandy loam	130-160	
B-8	>400	40	20	40	clay loam	160-294	
B-9	375	67	20	13	sandy loam	0-50	15.19.570 88.06.975
B-10	115	47	33	20	loam	50-100	
B-11	160	47	43	10	loam	100-150	
B-12	120	37	53	10	silt loam	150-170	
B-13	400	50	4	46	sandy clay		15.19.575 88.06.784
B-14	300	67	17	16	sandy loam	0-50	
B-15	100	53	27	20	sandy clay loam	50-95	
B-16	120	57	20	23	sandy clay loam	95-180	

Appendix B


Auger Probe 1 at Palmarejo
lbs/acre
500
400
300
200
100
0
A
Bt
Bg
Horizon
P Levels
N Levels
K Levels


Auger Probe 2 at Palmarejo
lbs/acre
500
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P Levels
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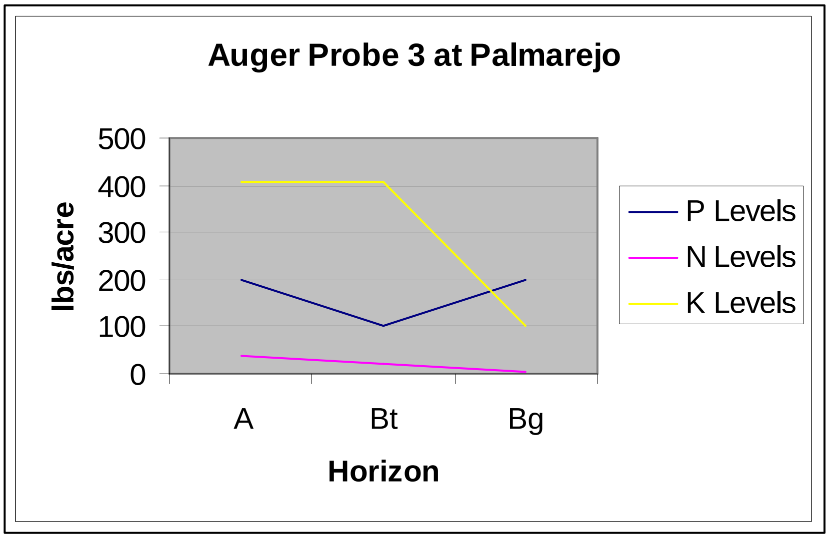
K Levels


Auger Probe 3 at Palmarejo
lbs/acre
500
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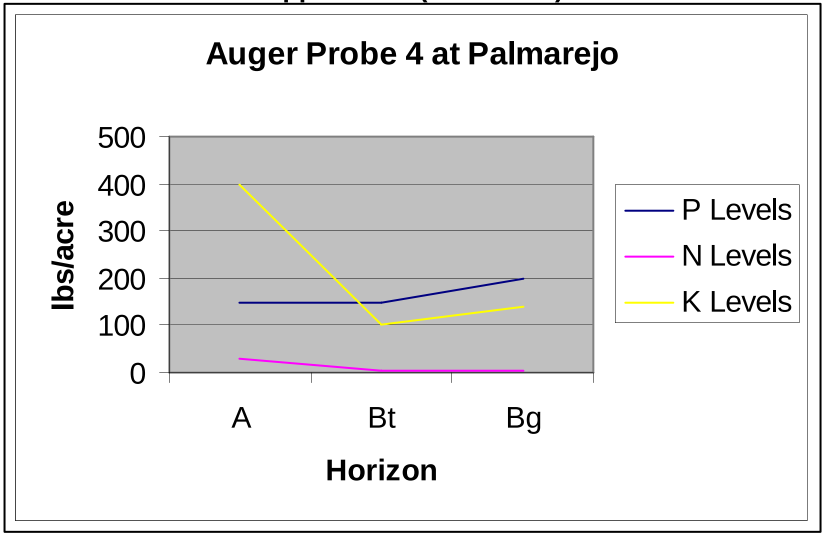
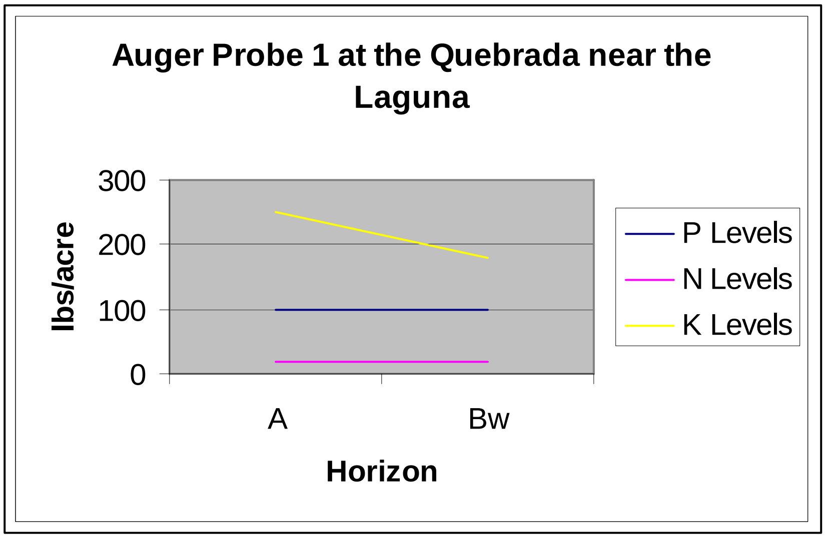
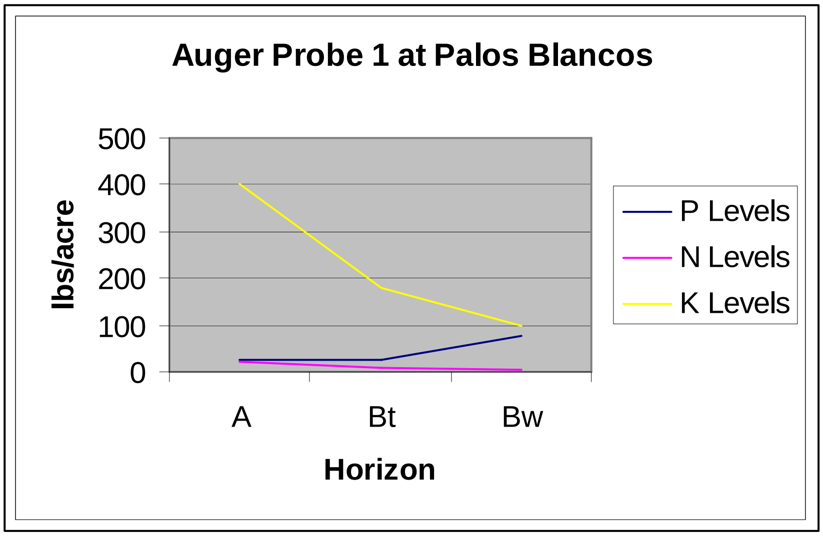
Horizon
P Levels
N Levels
K Levels

Appendix B (continued)







Appendix B (continued)