DETERMINATION OF ENGINEERING PROPERTIES OF TWO SOILS AT FOHREC (KADE) AND SIREC (KPONG)

BY

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DECLARATION

I, EMMANUEL DANSO-ACQUAH, do hereby declare that this work, DETERMINATION OF ENGINEERING PROPERTIES OF TWO SOILS AT FOHREC (KADE) AND SIREC (KPONG) , with the exception of cited references, was written and submitted by me in the University of Ghana from AUGUST, 2017 to MAY, 2018, under the supervision of Dr. Malcolm Josiah and Dr. Stephen A. Mickson.

I further declare that this work has not been submitted to University of Ghana or any other university.

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ABSTRACT

Agriculture, its operations, and soils properties are inter-related. Cultivation of crops; tillage, irrigation and farm operations, commuting to and from farm plot and building of structures are greatly influenced by the soil specifically its properties. Shear stress, cohesion and angle of friction are parameters that play major roles in influencing how soils are used or worked on. It is, therefore, important to determine the shear stress, cohesion and angle of friction of the soils in Kade and Kpong. As a result, a study was conducted on two soils from Forest and Horticulture Research Centre (FOHREC), Kade, and Soil and Irrigation Research Centre (SIREC), Kpong, at depth ranges of 0-15cm and 15-30cm under saturated and unsaturated conditions to determine the shear stress, cohesion and angle of friction to ascertain how they will affect tillage, traction and trafficability, irrigation and structures such as dams and foundations. Normal stress ranging from 1kg/cm^2 to 5kg/cm^2 was used as an independent variable to determine the stated properties. The results showed that the Kpong soil had a higher shear stress under all conditions than that of Kade soil. An interesting observation was made concerning the soil under unsaturated condition where at 3kg/cm^2 it behaved as if it is is under saturation. The normal stress had a significant effect ($p \leq 0.05$) on shear stress, cohesion and angle of friction, where increase in normal stress reflected an increase in shear stress and cohesion but a decrease in angle of friction. The research provided ample data on shear stress required for failure to occur normal to the shear plane, cohesion and coefficient of internal friction. These measurements are relevant and important for the design of farm equipment, farm structures such as dam wall, storage buildings, etc. Kpong soil (Akuse series) had a higher shear stress under all conditions than that of the Kade soil (Kokofu series).

Keywords: Shear Strength, Cohesion, Angle of friction, Trafficability, Tillage, Moisture content

DEDICATION

I dedicate this thesis to the Almighty God who has been my all in all.

ACKNOWLEDGEMENT

I would like to give honour and thanks to all who helped to make this work a success.

My deepest appreciation goes to my supervisors, Ing. Dr. Malcolm Josiah and Dr. Stephen A. Mickson and the Head of Department, Agricultural Engineering, University of Ghana, Dr. Edward Sabi, for their timely and unique support, encouragement and making time to patiently guide me and patiently review through countless revision of my work, with their constructive suggestions.

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My deepest gratitude also goes to my family. It is their love and support coupled with prayers which enabled me to be focus and finish up this work. I give a special thanks for the support and generosity shown by Mr. Frank Osei-Sekyereh, Mr. Peter Osei-Sekyereh, Miss Victoria Osei-Sekyereh, Mr. Joseph Danso Acquah, Mr. Maxwell Alfred Kay Adonteng and Miss Efua Afariwa Okyireh. I greatly value their place in my life.

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$T_{1, 2,3,4,5}$	-	Normal Stresses (kg/cm^2)
Mw	-	weight of cans containing wet soil samples (g)
Md	-	weight of cans containing dry soil samples (g)
Ws	-	Moisture content (%)
N	-	Number of blows
$\bar{x}$	-	Mean/Average
σ^2	-	Variance
σ	-	Standard deviation

CHAPTER ONE

1 INTRODUCTION

1.1 Background

Soil, as a medium, has a lot of influence on the material it interacts with. Be it a plant, a structure, a moving traction member, water, etc., it has a peculiar effect on each. The effects are mostly attributed to the physical properties of the soil, specifically, the engineering properties. Soil strength, the ability of the soil to resist deformation, is one of the engineering properties responsible for these effects.

Estimation of soil strength parameters are needed for the design of foundations, retaining walls, and pavements in civil engineering applications and for determining the resistance to traction and tillage tools (Fredlund and Valnapalli, 2002).

Soil strength, also, affects the performance of cultivation implements, seedling emergence and root development, least-limiting water range and trafficability in agricultural operations (Vanags et al., 2004).

A characteristic of soil strength that has great influence on machinery, due to its interaction with tractive members and tillage tools, is the shear strength of soils (Bashar, 2015).

The shear strength of the soil is a function of the draft force required by a tractor to pull an implement through the soil. The soil resistance to ploughing is due to the friction between the implement and the soil, cutting dimension and inertia. The higher the draft force, the higher the energy required by a tractor to pull an implement through the soil (Pitla et al., 2016).

Moisture, a property of the soil, also influences the efficiency of tillage implements and farm machinery. Trafficability of farm tractors and machinery are influenced by moisture content of the

soil (Earl, 1997). Soil compaction can be an advantage for structures and building, but it is not good for crop production, since it can affect root growth and allow little or no infiltration during irrigation making it undesirable in agricultural production (Jin et al., 2017).

Compaction is influenced by moisture content, the type of soil and amount/volume of compaction energy (weight, etc.) applied to the soil (Bui et al., 2014). The mechanical properties of the soil have an effect on traction and tillage implements, due to the soil-tool (metal) relation (Gill & Berg, 1967; Soil, U., & Suction, M., 1996). Therefore, these properties of soils are very important and have a great influence on agricultural and non-agricultural operations.

1.2 Problem Statement

The properties of soils have great influence on the materials that interacts with it. These properties influence the design (dimension and orientation) of the materials. It can either be a material for building, machinery for operations or tractive device which moves through the soil, irrigation scheduling, etc.

The soils at Kade and Kpong lack data on their engineering properties like shear strength, cohesion, deformation moduli and internal friction which are very important in the design of tillage tools; earth moving equipment; in estimating traction for the selection of traction devices and trafficability on deformable soil; predicting forces acting on a blade; implement power requirement for tillage and foundation (building of dams).

The lack of these vital data makes operators face some avoidable challenges like broken parts of implements and tractor getting stuck or difficulty in traction and trafficability during operations on the land which on my visit to the Kade area some of the tractor operators brought to my notice as some of the challenges they face there. There is, also, a high possibility of foundation defects in structures like building, dams, etc.

The purpose of this study is to determine the engineering properties of the selected agricultural soils.

1.3 Objectives

The objectives for this study are to determine and obtain shear strength (kg/cm^2), cohesion (kg/cm^2), angle of internal friction (°), plasticity limit and liquid limit of the respective soils at Kade and Kpong farms that will be of importance to the design of tools and equipment, traction and trafficability and power requirement for tillage.

1.4 Expected Outcome (Contribution to Knowledge)

Increase in agricultural machinery operation cost, poor structural foundation calculation and failure, poor trafficability, flooding due to irrigation etc. can be attributed to the absence of knowledge of certain engineering properties of soil that influence or account for these.

The absence of the knowledge of these parameters can be detrimental to human life, properties, economic and managerial policies of a farm enterprise. Information from this study will aid anyone who engages with the soil to know the requirements needed to work on it, be it foundations, dams, etc. Information can also be utilized in the designing of implement and tractive devices that can be used on it and soils with similar characteristics in the country.

CHAPTER TWO

2 LITERATURE REVIEW

2.1 Background

Soil as a medium is formed through weathering processes due to wind, water, mechanical and human activities. The kind of weathering process and the origin of the soil, make the nature of soils to look similar by observation, but their engineering properties are generally peculiar due to the topography, topology, climate, etc. of the area the soil is located (Craig, 2004).

2.2 Types of Soils in Ghana

Ghana lies between latitude 4º 44'N and 11º11' N and 3º 11'W and 1º11' E and bordered by the Republic of Togo on the east, Burkina Faso on the north, Côte d'Ivoiré on the west and the Gulf of Guinea on the south (MoFA, 1998).

Most soils of Ghana are from weathered parent materials, with alluvial soils (Fluvisols) and eroded shallow soils (Leptosols) common to all the ecological zones. (MoFA, 1998).

The soils in the forest zones are porous, well drained and generally loamy and are distinguished from those of the Savannah zones by greater accumulation of organic matter in the surface resulting from higher accumulation of biomass. They are generally grouped into Forest Oxisols and Forest Acid Gleysols. The soil properties and nature are influenced by the igneous, metamorphic and sedimentary rocks that are found at the place of formation. Soils of the Savannah zones, are low in organic matter, have high levels of iron concretions and are susceptible to severe erosion. (MoFA, 1998).

2.3 Engineering Properties of Soils

Engineering properties of soils are parameters that influence trafficability and design of traction members, the design of implements, the design of irrigation canals, the design of foundations for structures, etc. (Chen ,1999)

The engineering properties of the soil include; compaction, permeability, shear strength, stress-strain modulus (modulus of elasticity) and Poisson's ratio.

2.4 Effects of Soil Engineering Properties on Tillage Requirements and Workability

The draft and movement of tillage implements through the soil are greatly influenced by the properties of the soil. Soil strength, which is one of the engineering properties of the soil, is an important parameter that influences the performance of cultivation implements and the draft force required by a tractor to pull an implement through the soil (Adekalu et al., 2007A; Vanags et al., 2004),

Tillage is one of the agricultural operations that requires a lot of energy (Larson and Clyma, 1995), and this is due to the properties of the medium being worked on. There is the need, therefore, to know these properties, in order, to help in the design of appropriate implements

Studies had been carried out to propose new tools for tillage purposes and great effort has been put in to prove their advantages and operation configuration which are dependent on the engineering and mechanical properties related to the medium being worked on (Albiero et al., 2014).

The laws of nature and physical connections between the basic factors of the working processes and general resistances developing during friction between implements and soils were considered and rationale formula was developed as follows;

$$P_1 + P_2 + P_3 = fG + Kab + \xi\rho abv^2 \qquad 2.1$$

Where; f – Coefficient of friction of soil on metals

G – Gravitational force of plough, N

K – Coefficient of specific resistance, Pa

a & b – dimensions of soil slices, m

ξ – Coefficient that depends upon the form of mould board and properties of soil.

ρ – Density of soil, kg/m^3

v – Speed, m/s

(V.P. Goriachkin, 1927)

Soil, U., & Suction, M. (1996), used a model, based on the Universal Earth Moving Equation proposed by Recce (1994), to predict tillage force (Figure 2.1). The model has soil properties, tool parameters, and several dimensionless factors as functions and it is expressed as:

$$F = (\gamma h^2 N_\gamma + chN_c + qhN_q + C_\alpha hN_{c\alpha})b \quad 2.2$$

Where;

F- soil force [N], γ- the total unit weight of the soil [N/m^3], h-tool depth in the soil [m],

C- soil cohesion [N/m^2], C_α -soil tool adhesion [N/m^2], b- tool width [m], q-soil surcharge [N/m^2].

The dimensionless factors N_γ, N_c, N_q,$N_{c\alpha}$ are related to the internal frictional angle and soil tool friction angle.

Cohesion and weight are the highest contributors to draft. Soil-tool adhesion depends on the moisture content of the soil and, mostly, entirely from soil suction but contributes very little to the overall draft (Fountaine, 1954).

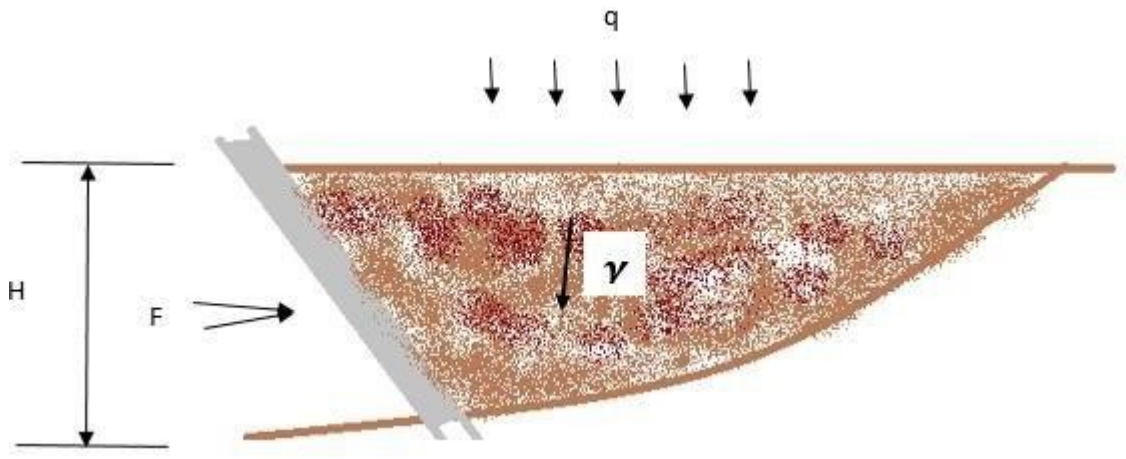

Figure 2.1 Tillage tool and soil failure pattern (Soil, U., & Suction, M.., 1996)

25 Trafficability and Traction In Relation To Soil Engineering Properties

Trafficability is the ability of the soil to support agricultural processes such as tillage, seeding, fertilization and harvesting.

The movement of vehicles and machinery on soils is influenced by two factors, the nature of the soil and the kind/ type of traction device. These two factors are basic for trafficability and traction of machinery. The nature of soil will determine the kind of traction device that will be used or adequate for effective movement. The main disadvantage or limitation to trafficability is mostly related to excess moisture content in the soil. A major contribution to traction and trafficability comes from the shear stress distribution of the soil (Soil, U., & Suction, M., 1996). Trafficability is an important factor in the farm operation. Farm operation can be interrupted when there is excessive moisture in the soil after a heavy rainfall. Hairaldsen and Sveistrup (1994), found out that farm tractors are better suited when the soil is not too wet so that the soil can support the machinery and skidding of the wheel can be avoided. Soil strength is one of the important factors affecting the bearing capacity of the soil, traction members, and tillage power requirement (Terzaghi et al., 1996).

The stickiness of soil is also another factor that affects trafficability and traction and it is dependent

on moisture content. The stickiness of the soil to track or tire surface has a major input on the continuity of interaction during farm operation. It can cause a parallel sliding or perpendicular tearing of a flat surface of the soil. These factors tend to impede the efficiency of farm operations, therefore leading to losses (Domzal, 1970).

Trafficability and traction are dependent on the cohesion, sinkage and compaction properties of the soil. The soil is trafficable if it has significant compressive strength to withstand the weight of the machinery, and significant shear strength to meet the traction requirement with acceptable wheel slip and soil damage (Simalenga and Have, 1994).

Knowledge of engineering properties of soils like the strength can assist in the estimation of traction. Soil, U., & Suction, M. (1996), used a strength prediction equation based on effective strength coefficients and soil-water characteristics that need only to be determined once for a given soil structure, to stimulate the behaviour of strength dependent process under different moisture conditions (Figure 2.3). Their equation used for predicting traction is of the form:

$$NT = \int_A [\tau \cos\theta - \sigma \sin\theta]\delta A \qquad 2.3$$

Where:

NT = net traction, τ=shear stress, σ =normal stress,

θ = angle between surface normal and the vertical at any point on the contact surface

A= contact surface area

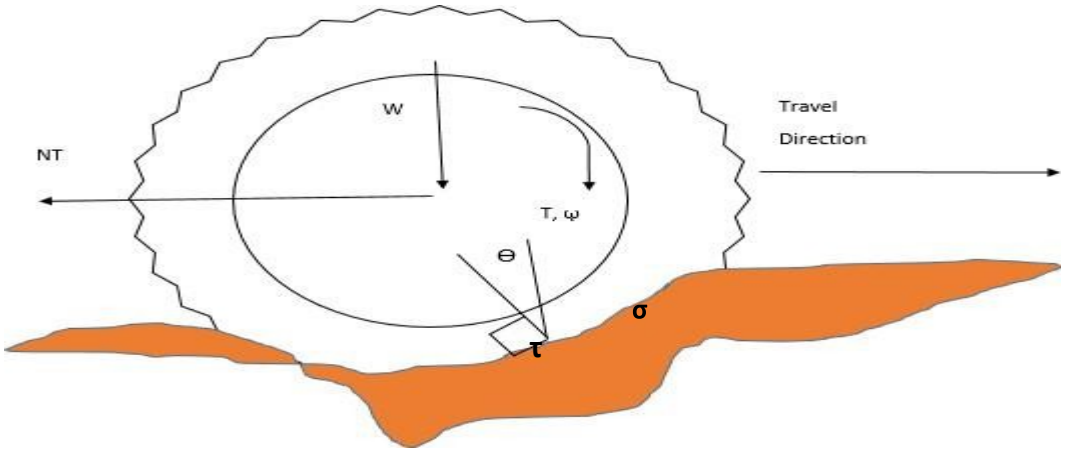

Figure 2.2 Traction model for the interaction between tire and soil (Soil, U., & Suction, M., 1996)

2.6 Compaction, Irrigation, Foundations and Root Extension In Relation To Soil Engineering Properties

The degree of compaction determines the strength of the soil or its bearing capacity (Mohshin and Farooq, 2017). Soils are compacted for the purpose of reducing subsequent settlement under working loads, this is good for dams and foundations of structures. Knowledge of shear strength of soil is important when constructing foundation or dam for irrigation reservoir, and the parameters needed are angle of internal friction and cohesion (Orininová and Nguyen, 2015). Though compaction has its own merits in terms of trafficability and foundations, it has a great disadvantage to irrigation and crop growth (Schmidt and Gaudin, 2017). Compaction reduces the voids in the soils, thus reducing hydraulic conductivity to take place in the soil, increases dry density and penetration resistance, and reduces the soil permeability to water leading to run off, erosion and adequate recharge of groundwater (Lu and Dong, 2017; Assouline, 2002; Ohu and Folorunso, 1987).

2.7 Effects of water on Soil Strength

Moisture content as a property of soil has a great part to play in the strength. The bonds in-between soil particles become stronger or weaker based on the moisture content in relation to the properties

of soil. Shear strength without changing the water content its strength remains the same. (Ghosh, 2013).

Moisture has an influence on most of the engineering properties of soils. It affects the mechanical behaviour and strength of soil (Mehrez, 2015). The Bahktin theory, graphically, explains the relation between moisture content and coefficient of friction during ploughing (Fiqure 2.2). The theory explains the coefficient of friction in relation to different levels of moisture content for different soils, specifically sand, sandy loam and loam of clay (Listopad and Demidov, 1986).

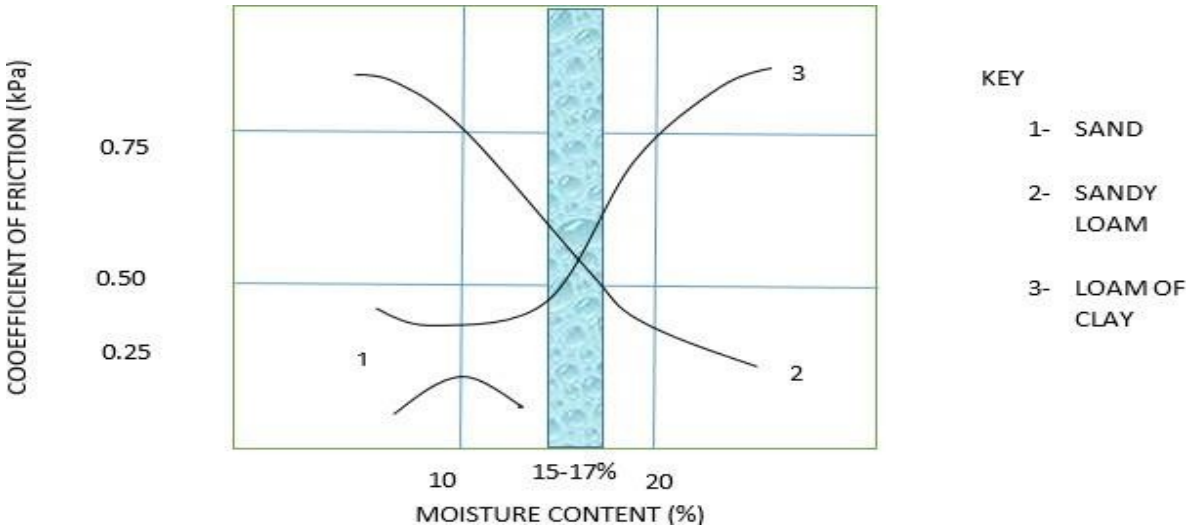

Figure 2.3 The Bahktin Theory

CHAPTER THREE

3 METHODOLOGY

3.1 Site

The studies were conducted at the Forest and Horticulture Research Centre (FOHREC) of the University of Ghana at Kade, located in the forest zone, and the Soil and Irrigation Research Centre (SIREC) of the University of Ghana at Kpong, located within Accra Plain in the coastal savannah zone. Kade is found on latitude of 6° 05' N and longitude of 0° 005'W with an elevation of 134m with a wind speed of 6 km/h SSW, humidity, 94%, dew point of 22 °C and an atmospheric pressure of 1014.22mbar (Media, 2020). Kpong as a site for study also has a latitude of 6° 09'N and longitude of 00° 04 E with a wind speed of 12 km/h SSW, humidity of 67 %, and an atmospheric pressure is 1014.22 mbar (Media, 2020).

3.2 Soil Sampling

A randomized block design (RBD) was adopted at both sites. The soils series are for Kade was Kokofu and that of Kpong is Akuse series Uncultivated fields measuring 100 m by 100 m, at both sites, were divided into 25 grids, with each grid measuring 20 m by 20 m (Figure 3.1). Five samples of undisturbed soil were, randomly, taken from each grid, at depth ranges of 0 to 15cm and 15cm to 30cm, respectively, using a 4.5 cm diameter core sampler, and labelled. A total of 250 samples were taken at each site. The soil samples, were used to determine the engineering properties of the sites.

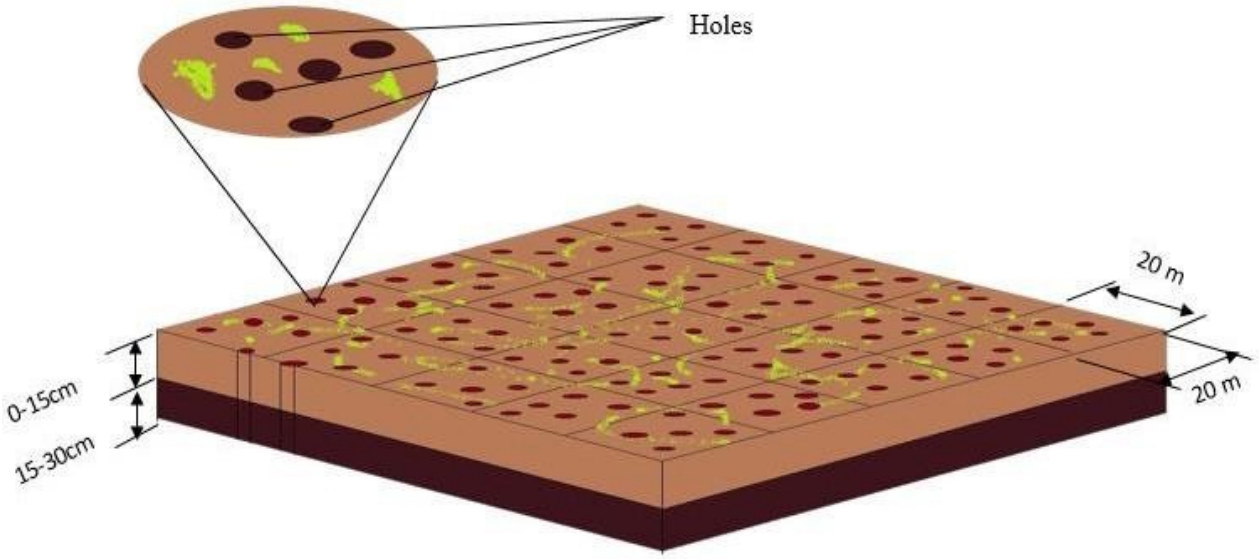

Figure 3.1 Field layout design

3.3 Determination of Atterberg limits (Liquid and Plastic Limits)

Atterberg Limits are five proposed "limits" that define the ranges in moisture content that a soil will behave in a solid, plastic or liquid state. These are the cohesion, sticky, shrinkage, plastic and liquid limits. The Atterberg limits of interest in these studies are the liquid limits (LL) and the plastic limits (PL) of the soils at the 2 sites.

Standard test procedures defined in ASTM Standard D4318 where followed in the determination of the liquid limits and plastic limits (ASTM, 2000). The limits are of importance because they affect tillage implements through soil. Soil sample of 250g was taken from the grids at the two sites were air-dried and pulverized to elemental particles. The air-dried soil samples were passed through a 0.425 mm sieve (#40 mesh) to obtain sieved soil fractions, which were then used to determine the liquid limits and plastic limits of the soils. The soil residue left on the sieve were discarded.

3.3.1 Liquid Limit

The Liquid Limit (LL) of a soil is the moisture content above which the soil changes from a plastic state to a viscous (liquid) state and behaves as a liquid. In these studies, this was determined using the Casagrande's cup method (ASTM, 2000) (Figure 3.2).

The height of fall of the Casagrande's cup was adjusted to exactly 10 mm from the point of contact on the base and the screws were tightened. One hundred and twenty gram (120g) were taken from the sieved fraction, and mixed, thoroughly, with distilled water in an evaporating dish to form a uniform paste. The mix was kept under humid conditions for some time, in order, to obtain uniform moisture distribution.

A portion of the moistened soil fraction was taken and put in the Casagrande's cup and the soil surface was smoothened, using a spatula, such that the depth at the point of maximum thickness was, approximately, 10 mm. A "V"-shaped groove was cut in the sample in the cup, using a grooving tool which was held perpendicular to the cup (Figure 3.2).

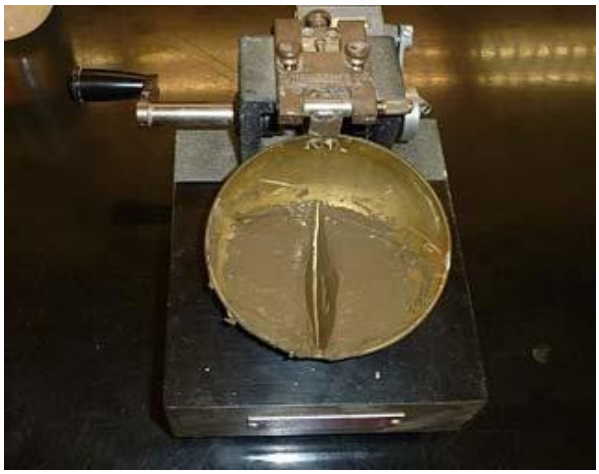

Figure 3.2 Casagrande's Cup

The cup was raised and dropped, through the 10 mm height, by turning the handle of the device at a rate of 2 revolutions per second (approximately 120 blows per minute). The number of blows (N), that will cause the two halves of the soil specimen in the Casagrande's cup to come in contact

at the bottom of the "V"-shaped groove, along a distance of 13 mm, due to flow, was counted and recorded. Some of the soil sample in the cup was collected, this included the portion of the groove, and the water content determined gravimetrically. The remainder of the soil in the cup was removed and mixed with the remaining soil fraction in the evaporating dish. Water was added to the mix to change the water content and the test repeated to determine the number of blows (N) and the water content. This was done a certain number of times. The number of blows (N), for each test, was plotted against the corresponding water content (w), with the number of blows as the abscissa and the moisture content as the ordinate. The liquid limit (LL) for that soil sample was, then, determined at N = 25 (Figure 3.3). This procedure was repeated 5 times for each soil sample. The process was, then, replicated for all the 250 soil samples taken at the two sites (Appendix A).

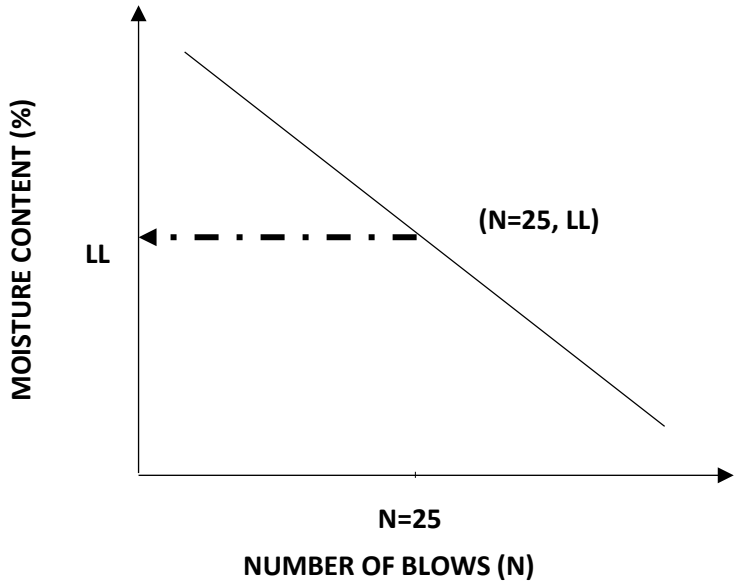

Figure 3.3 Flow curve for the liquid limit

3.3.2 Plastic Limit

The Plastic Limit (PL) of a soil is the moisture content at which a sample of the soil can be rolled by hand into a thread of 3 mm diameter without breaking into pieces. This is also the moisture

content above which the soil behaves plastically.

About 2 grams of the sieved soil fraction was moistened so that it can be easily rolled between the hands (Figure 3.4). The moistened soil was then rolled, using the palm, on a glass plate into a uniform thread. When the diameter was 3 mm and the soil thread did not crumble, it was broken into pieces, kneaded to reduce the water content slightly, and re-rolled. This sequence was repeated several times till the soil thread crumbled at 3 mm diameter. The crumbled soil thread was gathered into a can and the gravimetric water content (plastic limit) determined. The procedure was repeated three times, for the same sieved soil fraction, to obtain an average value. The procedure was, then, replicated for all the 250 soil samples taken at the two sites and the values recorded (Appendix A).

The numerical difference between the Liquid Limit and Plastic Limit is termed the Plasticity Index, that is:

Plasticity index (PI) = Liquid Limit (LL) – Plastic Limit (PL) 3.1

Figure 3.4 Rolled sample of soil

3.4 Determination of Shear Strength, Cohesion, and Angle of Friction of Soil

A conventional direct shear strength apparatus was used to determine the shear strength parameters (cohesion (c) and angle of friction (ϕ)) of the soils at the two sites. These were determined under unsaturated and saturated conditions (Figure 3.5)

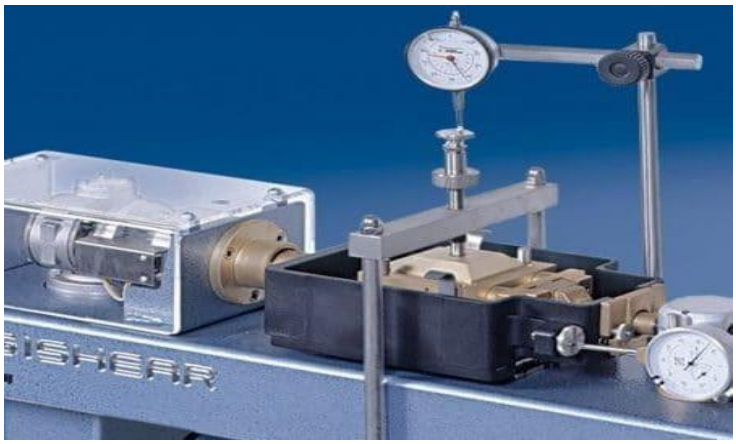

Figure 3.5 Direct Shear Apparatus

The internal dimensions of the shear box were measured and the average thickness of the grid plates determined. The two halves of the box were assembled, using the locking screws, and the base plate was placed at the bottom. The porous stone was then placed above the bottom plate and the grid plate was placed on it, keeping the serrations on the grid plate at right angles to the direction of shear. The shear box was weighed together with the base plate, grid plate and porous stone and the weight noted. Undisturbed soil sample was, carefully, placed above the grid plate in the shear box and the weight of the shear box with the soil sample was recorded. The upper grid plate, the porous stone and the loading pad were placed, respectively, one above the other on the soil sample (Figure 3.6).

The set was placed in a container and mounted on the loading frame, such that the proving ring was in contact with the loading pad. For saturated tests, the container was filled with water. The loading yoke was then placed on the steel ball of the loading pad. A dial gauge was fitted to the loading yoke to measure vertical displacement, and another gauge fitted to the container to measure horizontal displacement. Weights were then placed on the loading yoke to apply a normal stress of 1 kg/cm^2 (T_1). The sample was allowed to consolidate under the applied normal stress, and the reading of the vertical displacement dial gauge noted. Both dial gauges and the proving ring were

then set to zero. Horizontal shear load was then applied at a constant rate of strain of 0.2 cm/minute and the readings of the proving ring, the vertical displacement dial gauge and the horizontal displacement dial gauge, were recorded at regular time intervals till the specimen failed. The shear box was removed and the water content of the specimen determined. The procedure was repeated for the same specimen at different normal stresses of 2 kg/cm^2, 3 kg/cm^2, 4 kg/cm^2 and 5 kg/cm^2 (T_2, T_3, T_4, and T_5 respectively). The choice of the normal stresses was made based on the manual of the apparatus that was used (HEICO II direct shear apparatus). The process was replicated five times for all the 250 soil samples taken at the two sites and the values recorded (Appendix B).

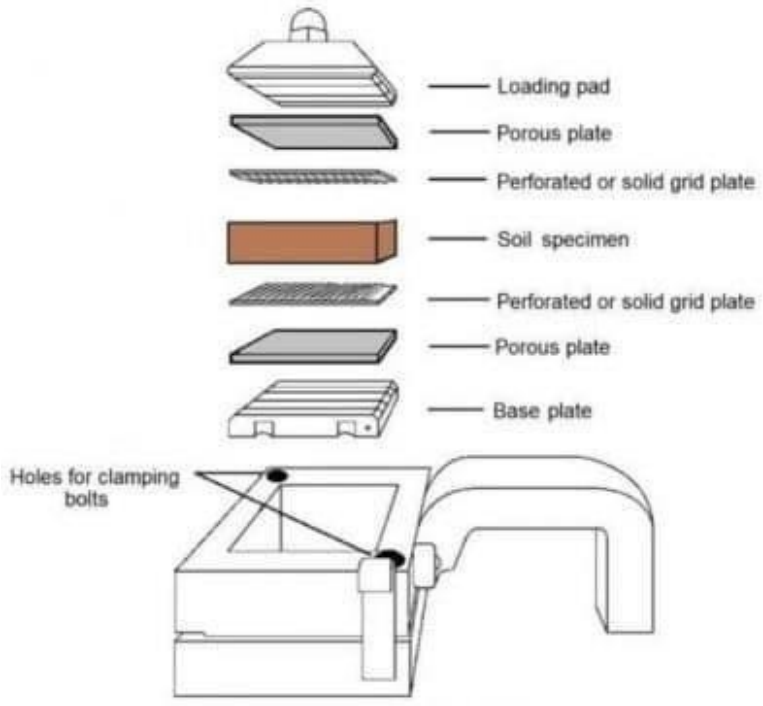

Figure 3.6 Order of Arrangement of Parts in Shear Box

3.5 Determination of Soil Moisture Content

The moisture contents of the soil samples after each test were determined using the oven drying method. The soil sample was put into well-labelled can after a test and the weight of the can containing the soil sample was determined and recorded as M_w. The can with the soil sample was,

then, put in an oven set at 105°C for 24 hours. After oven-drying, the can with the soil sample was put in a desiccator to cool. The can with the dried soil sample was removed from the desiccator, weighed and recorded as M_d.

The moisture content was determined as follows:

$$\text{Moisture (Ws)} = \frac{Mw - Md}{Mds} \times 100 \qquad 3.2$$

Mds= Md – Mc; where Mc is mass of can and Mds is mass of dry soil.

3.6 Data Analysis

3.6.1 Atterberg limits (Liquid and Plastic Limits)

Individual data obtained from the liquid limit and the plastic limit tests were averaged (Appendix A) and used to determine the mean values ($\bar{x}$ for the grids, variances (σ^2) and standard deviation (σ) which represent the variability in the data. The mean values for the sites were then estimated at the confidence level of 95% as ($\bar{x}$+2 σ).

3.6.2 Derived Data of Shear, Cohesion, and Angle of Friction of Soils

Data from the shear test was used to determine the cohesion and the angle of friction of the soils at the sites, based on the Mohr-Coulomb failure criterion graph (Figure 3.7) and using the shear strength equation:

$$= c + \sigma_n tan\emptyset \qquad 3.3$$

where τ=shear stress (kg/cm^2), c= cohesion (kg/cm^2), σ_n =normal stress (kg/cm^2) and $\emptyset$ = angle of friction (˚).

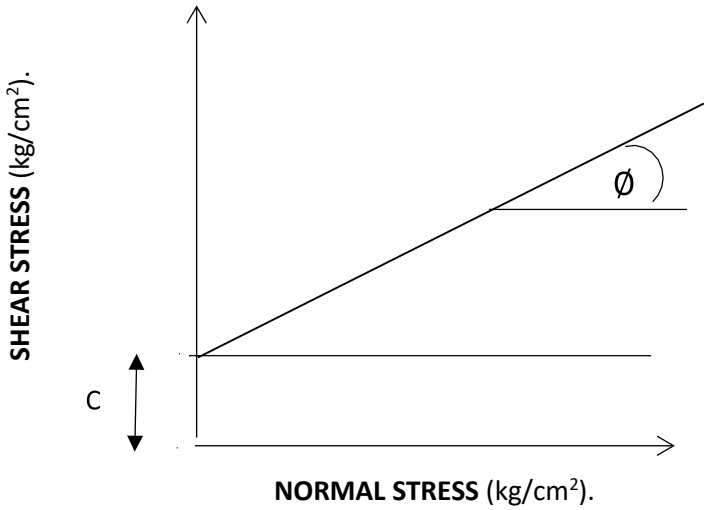

Figure 3.7 Mohr-Coulomb failure criterion graph

These parameters were then determined, under saturated and unsaturated conditions, for the 250 samples of soil taken from the sites (Appendix B)

A randomized block design was used to study the shear stress, cohesion and angle of friction data. The data were analysed separately by using the one-way Analysis of Variance (ANOVA) to detect whether there were significant differences between the means of the shear stress, cohesion and angle of friction. The one-way Analysis of Variance (ANOVA) was used because the experiment consist of one factor; normal stress (kg/cm^2).

The nature of the data of the shear, cohesion and angle of friction describes the soils' behaviour under different forces of engagement at respective moisture conditions and depths.

CHAPTER 4

4 RESULTS AND DISCUSSION

Results of the studies conducted on the fields at Kade and Kpong are presented in this chapter under saturated and unsaturated conditions. An analysis of variance was used (at $p \leq 0.05$ significance level) to measure variations in means of the measured soil parameters at the different levels of normal stress. Results obtained are further compared to other findings and discussed to ascertain the cogency and impact of the findings of this study.

4.1 Determination of Liquid Limits (LL) and Plasticity Index (PI)

Determination of liquid limits (LL) and plastic limits were part of the main objectives of the study. Tables 4.1 shows the average values for the liquid and plastic limits of the soil for each grid at the two depth ranges at Kade, and Table 4.2 shows the average values for the liquid and plastic limits of the soil for each grid at the two depth ranges at Kpong.

Table 4.1 Average values of Liquid Limit and Plastic Limit of Kade Soil at each grid

DEPTH	0-15 CM		15-30 CM	
GRID	LL (%)	PI (%)	LL (%)	PI (%)
1	21.2	10.3	23.3	11.2
2	20.4	10.0	22.3	10.0
3	20.1	9.6	22.7	9.3
4	21.0	10.3	22.4	9.8
5	21.0	10.8	22.9	10.1
6	20.6	11.0	22.5	10.2
7	20.9	10.5	21.5	9.9
8	19.9	10.3	22.1	10.2
9	20.5	10.7	21.3	10.0
10	20.0	10.3	21.0	10.0
11	20.8	9.6	20.5	9.8
12	21.1	10.8	21.4	9.9
13	21.0	11.0	21.4	9.9
14	21.0	9.6	21.7	9.9
15	20.5	10.0	20.7	9.8
16	20.7	9.6	21.5	9.9

17	21.0	10.3	21.4	10.0
18	21.2	10.5	20.8	9.8
19	21.0	11.0	20.2	10.0
20	20.9	10.3	22.4	10.0
21	21.0	10.0	21.4	10.3
22	21.0	11.0	21.5	10.2
23	21.0	10.5	21.1	9.3
24	20.5	9.6	20.2	11.2
25	21.0	10.3	21.4	9.9
Mean ($\bar{x}$)	**20.8**	**10.3**	**21.6**	**10.0**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i - \bar{x})^2}$	**0.36**	**0.46**	**0.80**	**0.40**

LL-LIQUID LIMIT PL-PLASTIC LIMIT

Table 4.2 Average values of Liquid Limit and Plastic Limit of Kpong Soil at each grid

DEPTH	**0-15 CM**		**15-30 CM**	
GRID	**LL (%)**	**PI (%)**	**LL (%)**	**PI (%)**
1	23.2	10.3	26.6	9.1
2	25.0	9.9	29.5	10.4
3	24.0	9.5	28.1	10.2
4	23.0	9.3	29.7	10.4
5	25.5	10.5	29.0	10.6
6	25.5	10.5	29.9	10.8
7	24.9	10.3	29.4	10.9
8	24.3	9.8	29.0	10.4
9	24.5	10.2	26.6	10.4
10	24.0	10.6	29.8	10.4
11	23.5	10.5	29.0	9.8
12	24.3	9.9	26.5	10.2
13	25.5	9.8	28.9	10.6
14	24.1	9.1	29.7	10.0
15	25.5	10.6	29.8	10.7
16	24.0	9.8	28.1	10.1
17	24.2	10.6	29.8	9.7
18	25.5	9.8	26.6	10.6
19	24.7	9.8	29.9	10.0
20	24.3	10.3	29.7	10.5

21	23.2	10.1	29.7	10.2
22	24.2	10.3	29.7	10.2
23	25.5	9.6	29.4	10.6
24	24.3	10.1	29.7	10.7
25	23.2	9.2	28.8	10.4
Mean($\bar{x}$)	**24.4**	**10.0**	**28.9**	**10.3**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i - \bar{x})^2}$	**0.78**	**0.43**	**1.14**	**0.38**

LL-LIQUID LIMIT PL-PLASTIC LIMIT

The spatial variation in the average values for the liquid limit determined at the 25 grid points for the soil at Kade, at depth 0-15 cm and depth 15-30 cm ranged between 19.9% and 21.2% moisture content with a mean value of 20.8% and between 20.2% and 23.2% moisture content with amean value of 21.6% respectively, whilst the spatial variation in the average values for the plastic limit ranged between 9.6% and 11.0% moisture content with a mean value of 10.3% and 9.1% and 11.2% moisture content with a mean value of 10% respectively (Table 4.1).

The spatial variation in the average values for the liquid limit determined at the 25 grid points for the soil at Kpong, at depth 0-15 cm and depth 15-30 cm ranged between 23.0% and 25.5% moisture content with a mean value of 24.4% and between 26.5 % and 29.9% moisture content with a mean value of 28.9% respectively, while the spatial variation in the average values for the plastic limit ranged between 9.1% and 10.6% moisture content with a mean value of 10% and 9.1% and 10.9% moisture content with a mean value of 10.3% respectively (Table 4.2).

A comparison between the two soils shows a higher liquid limit for the Kpong soil both at the 0-15cm depth range and the 15-30cm depth range , however, the two soils have about the same plastic limit at both depth ranges.

4.2 Determination of soil shear stress

The average shear stresses under the various applied normal stresses at the grids, under saturated and unsaturated conditions, for the soils at Kade and Kpong are shown in Appendice C, with the mean values and their standard deviations for the various depth ranges shown in Table 4.3 to Table 4.10.

Table 4.3 Mean Shear Strength corresponding to the different normal stress for Kade (0-15cm) corresponding to Saturated Condition

GRID	SHEAR UNDER NORMAL STRESS (kg/cm^2)				
	T1	T2	T3	T4	T5
Mean ($\bar{x}$)	**0.2264**	**0.3626**	**0.4305**	**0.5624**	**0.6524**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i-\bar{x})^2}$	**0.0041**	**0.0021**	**0.0030**	**0.0026**	**0.0024**

Table 4.4 Mean Shear Strength corresponding to the different normal stress for Kpong (0-15cm) corresponding to Saturated Condition

GRID	SHEAR UNDER NORMAL STRESS (kg/cm^2)				
	T1	T2	T3	T4	T5
Mean($\bar{x}$)	**0.4514**	**0.5898**	**0.6119**	**0.7494**	**0.8833**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i-\bar{x})^2}$	**0.0021**	**0.001**	**0.001**	**0.003**	**0.001**

Table 4.5 Mean Shear Strength corresponding to the different normal stress for Kade (15-30cm) corresponding to Saturated Condition

GRID	SHEAR UNDER NORMAL STRESS (kg/cm²)				
	T1	T2	T3	T4	T5
Mean($\bar{x}$)	**0.8892**	**1.1254**	**1.6517**	**2.2073**	**2.5361**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i-\bar{x})^2}$	**0.0452**	**0.0102**	**0.00074**	**0.0052**	**0.0093**

Table 4.6 Mean Shear Strength corresponding to the different normal stress for Kade (15-30cm) corresponding to Saturated Condition

GRID	SHEAR UNDER NORMAL STRESS (kg/cm²)				
	T1	T2	T3	T4	T5
Mean($\bar{x}$)	**0.8892**	**1.1254**	**1.6517**	**2.2073**	**2.5361**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i-\bar{x})^2}$	**0.0452**	**0.0102**	**0.00074**	**0.0052**	**0.0093**

Table 4.7 Mean Shear Strength corresponding to the different normal stress for Kade (0-15cm) corresponding to Unsaturated Condition

GRID	SHEAR UNDER NORMAL STRESS (kg/cm²)				
	T1	T2	T3	T4	T5
Mean($\bar{x}$)	**0.9121**	**1.2549**	**0.8627**	**0.7214**	**0.8538**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i-\bar{x})^2}$	**0.111**	**0.0015**	**0.0056**	**0.0015**	**0.0068**

Table 4.8 Mean Shear Strength corresponding to the different normal stress for Kpong (0-15cm) corresponding to Unsaturated Condition

GRID	SHEAR UNDER NORMAL STRESS (kg/cm^2)				
	T1	T2	T3	T4	T5
Mean($\bar{x}$)	**2.2394**	**2.5219**	**2.1516**	**2.3232**	**2.2388**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i-\bar{x})^2}$	**0.000**	**0.000**	**0.000**	**0.001**	**0.000**

Table 4.9 Mean Shear Strength corresponding to the different normal stress for Kade (15-30cm) corresponding to Unsaturated Condition

GRID	SHEAR UNDER NORMAL STRESS (kg/cm^2)				
	T1	T2	T3	T4	T5
Mean($\bar{x}$)	**0.5857**	**1.2004**	**0.9187**	**1.1134**	**1.1575**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i-\bar{x})^2}$	**0.0034**	**0.0122**	**0.0014**	**0.0150**	**0.0026**

Table 4.10 Mean Shear Strength corresponding to the different normal stress for Kpong (15-30cm) corresponding to unsaturated Condition

GRID	SHEAR UNDER NORMAL STRESS (kg/cm^2)				
	T1	T2	T3	T4	T5
Mean($\bar{x}$)	**2.8918**	**2.9207**	**2.1613**	**2.4214**	**2.5613**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i-\bar{x})^2}$	**0.001**	**0.001**	**0.001**	**0.000**	**0.001**

It can be observed that the mean share strength values under the different normal stresses for the different depth ranges for the kpong soil were greater than that for the Kade soil. This can be attributed to the high clay content of the Kpong soil.

The mean shear strength values obtained were compared at the defined depths of 0-15cm and 15-30cm, Table 4.11 to Table 4.14, to ascertain the similarities and differences in soil properties at the various depths.

Table 4.11. Mean Shear stress of the Kade soil at 0-15cm and 15-30cm under saturated condition.

Normal stress (kg/m^2)	Mean Shear Stress (kg/m^2) Depth (0-15cm)	Mean Shear Stress (kg/m^2) Depth (15-30cm)
1	0.2264	0.8892
2	0.3626	1.1254
3	0.4305	1.6517
4	0.5624	2.2073
5	0.6524	2.5361

Table 4.12 Mean Shear stress of the Kade soil at 0-15cm and 15-30cm under unsaturated condition.

Normal stress (kg/m^2)	Mean Shear Stress (kg/m^2) Depth (0-15cm)	Mean Shear Stress (kg/m^2) Depth (15-30cm)
1	0.9121	0.5857
2	1.2549	1.2004
3	0.8627	0.9184
4	0.7214	1.1134
5	0.8538	1.575

Table 4.13. Mean Shear stress of the Kpong soil at 0-15cm and 15-30cm under saturated condition.

Normal stress (kg/m^2)	Mean Shear Stress (kg/m^2) Depth (0-15cm)	Mean Shear Stress (kg/m^2) Depth (15-30cm)
1	0.4514	2.9120
2	0.5898	3.2420
3	0.6119	3.4102
4	0.7494	3.4521
5	0.8833	3.6713

Table 4.14 Mean Shear stress of the Kpong soil at 0-15cm and 15-30cm under unsaturated condition.

Normal stress (kg/m^2)	Mean Shear Stress (kg/m^2) Depth (0-15cm)	Mean Shear Stress (kg/m^2) Depth (15-30cm)
1	2.2394	2.8918
2	2.5219	2.9207
3	2.1519	2.1613
4	2.3232	2.4214
5	2.2388	2.5613

The mean values of Kade and Kpong show similar trends. The lower horizon (15-30 cm) shows a greater shear strength than the upper part (0-15cm) for both Kade and Kpong soils. This is an indication that working within the upper range (0-15 cm) of the soils during tillage operations will require less draft force compared to working within the lower range (15-30 cm). For the Kpong soil, under unsaturated condition, both depth ranges have higher shear strength which will require a high draft force.

As far as irrigation is concerned, the soil at Kade (both depth ranges), and the upper range of the soil at Kpong, under saturated conditions, will have a higher hydraulic conductivity than the lower range of the Kpong soil, which has a greater shear stress, since the soil particles are closely packed (higher soil strength).

The lower soil horizons at both Kade and Kpong have high shear strength, which means they have a certain adequate bearing pressure than the upper range of all the soils. They therefore have good support for foundation footing.

The difference between the saturated and unsaturated conditions is that the mean values of the shear under saturated conditions are larger than those of the unsaturated condition at the lower horizon (15-30cm).

On the other hand, shear strength values under unsaturated condition, there, are higher than those

under saturated condition at the upper horizon (0-15 cm). Nevertheless, at 15-30 cm under both saturated and unsaturated conditions the shear stress is larger than at the of 0-15cm depth. This is to say that the moisture content had a great influence on the shear of the Kpong soil at the upper part (0-15 cm) under relative conditions of saturated and unsaturated. The mean values increase generally as normal stress increase.

Plots of mean shear stress against normal stress for the Kade and Kpong under saturated conditions are presented in appendix C. It was observed that the shear strength of the soils, both at Kade and Kpong, increased with increasing normal stress under saturated conditions.

Plots of mean shear stress against normal stress for the soils at Kade and Kpong under unsaturated conditions are presented in appendix C. It was observed that under unsaturated conditions, the shear strength of the soils, both at Kade and Kpong, reduced and then increased again after the application of normal stress of 2 kg/cm^2 to 3 kg/cm^2. A similar effect was observation by Yokoi (1968), who attributed these phenomena to the soils being brought to saturated state between that ranges.

4.3 Determination of cohesion

The average cohesion values obtained for the grids, under saturated and unsaturated conditions, for the soils at Kade and Kpong are shown in Appendice C, with the mean values and their standard deviations, for the various depth range, shown in Table 4.15 to Table 4.22.

It was observed that cohesion increases as normal stress is increased, a trend which is similar to that shown by the shear stress. The similarity in the trend of the shear and cohesion is due to a reduction in moisture content as normal stress increases.

From table 4.15 and 4.19, it was found out that the result of the cohesion of the soil showed similar trend, which can be attributed to the nature of the upper part of the soil that is more sandy loam

and has a weaker bond whether saturated or not. The cohesion of the Kpong soil was found to be greater than that of Kade soil.

Table 4.15 Mean Cohesion Data for Kade (0-15cm) under Saturated Condition

GRID	COHESION UNDER NORMAL STRESS (kg/cm^2)				
	T1	T2	T3	T4	T5
Mean($\bar{x}$)	**0.125**	**0.228**	**0.154**	**0.395**	**0.407**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i-\bar{x})^2}$	**0.002**	**0.008**	**0.002**	**0.006**	**0.004**

Where; T1=1 N/m^{-2}, T2=2 N/m^{-2}, T3=3 N/m^{-2}, T4=4 N/m^{-2}, T5=5 N/m^{-2}

Table 4.16 Mean Cohesion Data for Kpong (0-15cm) under Saturated Condition

GRID	COHESION UNDER NORMAL STRESS (kg/cm^2)				
	T1	T2	T3	T4	T5
Mean($\bar{x}$)	**0.217**	**0.331**	**0.448**	**0.464**	**0.608**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i-\bar{x})^2}$	**0.028**	**0.011**	**0.028**	**0.006**	**0.005**

Where; T1=1 N/m^{-2}, T2=2 N/m^{-2}, T3=3 N/m^{-2}, T4=4 N/m^{-2}, T5=5 N/m^{-2}

Table 4.17 Mean Cohesion Data for Kade (15-30cm) under Saturated Condition

GRID	COHESION UNDER NORMAL STRESS (kg/cm^2)				
	T1	T2	T3	T4	T5
Mean($\bar{x}$)	**0.288**	**0.581**	**0.859**	**1.243**	**1.385**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i-\bar{x})^2}$	**0.022**	**0.007**	**0.001**	**0.006**	**0.007**

Where; T1=1 N/m^{-2}, T2=2 N/m^{-2}, T3=3 N/m^{-2}, T4=4 N/m^{-2}, T5=5 N/m^{-2}

Table 4.18 Mean Cohesion Data for Kpong (15-30cm) under Saturated Condition

GRID	COHESION UNDER NORMAL STRESS (kg/cm^2)				
	T1	T2	T3	T4	T5
Mean($\bar{x}$)	**1.860**	**2.127**	**2.023**	**2.242**	**2.353**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i-\bar{x})^2}$	**0.002**	**0.004**	**0.003**	**0.002**	**0.015**

Where; T1=1 N/m^{-2}, T2=2 N/m^{-2}, T3=3 N/m^{-2}, T4=4 N/m^{-2}, T5=5 N/m^{-2}

Table 4.19 Mean Cohesion Data for Kade (0-15cm) under Unsaturated Condition

GRID	COHESION UNDER NORMAL STRESS (kg/cm^2)				
	T1	T2	T3	T4	T5
Mean($\bar{x}$)	**0.492**	**1.138**	**0.613**	**0.611**	**0.480**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i-\bar{x})^2}$	**0.009**	**0.006**	**0.007**	**0.004**	**0.007**

Where; T1=1 N/m^{-2}, T2=2 N/m^{-2}, T3=3 N/m^{-2}, T4=4 N/m^{-2}, T5=5 N/m^{-2}

Table 4.20 Mean Cohesion Data for Kpong (0-15cm) under Unsaturated Condition

GRID	COHESION UNDER NORMAL STRESS (kg/cm^2)				
	T1	T2	T3	T4	T5
Mean($\bar{x}$)	**0.219**	**0.325**	**0.447**	**0.462**	**0.623**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i-\bar{x})^2}$	**0.026**	**0.002**	**0.004**	**0.002**	**0.003**

Where; T1=1 N/m^{-2}, T2=2 N/m^{-2}, T3=3 N/m^{-2}, T4=4 N/m^{-2}, T5=5 N/m^{-2}

GRID	COHESION UNDER NORMAL STRESS (kg/cm^2)				
	T1	T2	T3	T4	T5
Mean($\bar{x}$)	**0.735**	**0.835**	**0.903**	**0.964**	**1.041**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i-\bar{x})^2}$	**0.006**	**0.006**	**0.010**	**0.014**	**0.021**

Where; T1=1 N/m^{-2}, T2=2 N/m^{-2}, T3=3 N/m^{-2}, T4=4 N/m^{-2}, T5=5 N/m^{-2}

Table 4.22 Mean Cohesion Data for Kpong (15-30cm) under Unsaturated Condition

GRID	COHESION UNDER NORMAL STRESS (kg/cm^2)				
	T1	T2	T3	T4	T5
Mean($\bar{x}$)	**2.152**	**1.968**	**1.914**	**2.021**	**2.152**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i - \bar{x})^2}$	**0.001**	**0.003**	**0.002**	**0.002**	**0.001**

Where; T1=1 N/m^{-2}, T2=2 N/m^{-2}, T3=3 N/m^{-2}, T4=4 N/m^{-2}, T5=5 N/m^{-2}

The mean cohesion values obtained were compared at the defined depths of 0-15cm and 15-30cm, Table 4.23 to Table 4.26, to ascertain the similarities and differences in soil properties at various depths.

Table 4.23. Mean Cohesion of the Kade soil at 0-15cm and 15-30cm under saturated condition.

Normal stress (kg/m^2)	Mean Cohesion Stress (kg/m^2) Depth (0-15cm)	Mean Cohesion Stress (kg/m^2) Depth (15-30cm)
1	**0.125**	**0.288**
2	**0.228**	**0.581**
3	**0.154**	**.859**
4	**0.395**	**1.243**
5	**0.407**	**1.385**

Table 4.24 Mean of Cohesion of the Kade soil at 0-15cm and 15-30cm under unsaturated condition.

Normal stress (kg/m^2)	Mean Cohesion Stress (kg/m^2) Depth (0-15cm)	Mean Cohesion Stress (kg/m^2) Depth (15-30cm)
1	0.492	0.735
2	1.138	0.835
3	0.613	0.903
4	0.611	0.964
5	0.480	1.041

Table 4.25 Mean Cohesion of the Kpong soil at 0-15cm and 15-30cm under saturated condition.

Normal stress (kg/m^2)	Mean Cohesion Stress (kg/m^2) Depth (0-15cm)	Mean Cohesion Stress (kg/m^2) Depth (15-30cm)
1	0.217	1.860
2	0.331	2.127
3	0.448	2.023
4	0.464	2.242
5	0.608	2.353

Table 4.26 Mean of Cohesion of the Kpong soil at 0-15cm and 15-30cm under unsaturated condition.

Normal stress (kg/m^2)	Mean Cohesion Stress (kg/m^2) Depth (0-15cm)	Mean Cohesion Stress (kg/m^2) Depth (15-30cm)
1	0.219	2.152
2	0.325	1.968
3	0.447	1.914
4	0.462	2.021
5	0.623	2.152

The 15-30cm soil depth has slightly higher mean cohesion values cohesion than 0-15cm range under saturated and unsaturated conditions for both Kade and Kpong soils. The effects of cohesion on tillage, irrigation, structures, etc are the same as that of shear stress. As the soil cohesion increases,

there is the need for more draft force.

Plots of mean cohesion values against normal stress for Kade and Kpong under saturated and unsaturated conditions are presented in appendix C. It was observed that cohesion increased with increasing normal stress under saturated and unsaturated conditions at both Kade and Kpong. The dips in the graphs are instantaneous response/effect on the cohesion of thesoil as the applied stress is increased but then rises up again.

4.4 Determination of angle of friction

The average value for angle of friction obtained for the grids, under saturated and unsaturated conditions, for the soils at Kade and Kpong are shown in Appendix C, with the mean values and their standard deviations, for the various depth range, shown in Table 4.27 to Table 4.34.

It was observed that the angle of friction decreases as normal stress is increased, which is confirmed by Chetty et al. (2018). This shows an inverse relationship between angle of friction and both shear strength and cohesion of the soils at Kade and Kpong at both depth ranges.

Table 4.27 Mean Angle of Friction Data for Kade (0-15cm) under Saturated Condition

GRID	**ANGLE OF FRICTION UNDER NORMAL STRESS** (°)				
	T1	T2	T3	T4	T5
Mean($\bar{x}$)	**5.60**	**3.84**	**5.23**	**2.37**	**2.80**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i-\bar{x})^2}$	**1.905**	**0.340**	**0.136**	**0.099**	**0.114**

Table 4.28 Mean Angle of Friction Data for Kpong (0-15cm) under Saturated Condition

GRID	ANGLE OF FRICTION UNDER NORMAL STRESS (°)				
	T1	T2	T3	T4	T5
Mean($\bar{x}$)	**13.19**	**7.36**	**3.13**	**4.07**	**3.15**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i-\bar{x})^2}$	**0.197**	**0.308**	**0.050**	**0.095**	**0.052**

Table 4.29 Mean Angle of Friction Data for Kade (15-30cm) under Saturated Condition

GRID	ANGLE OF FRICTION UNDER NORMAL STRESS (°)				
	T1	T2	T3	T4	T5
Mean($\bar{x}$)	**31.16**	**15.22**	**14.79**	**13.55**	**12.97**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i-\bar{x})^2}$	**1.905**	**0.340**	**0.136**	**0.099**	**0.114**

Table 4.30 Mean Angle of Friction Data for Kpong (15-30cm) under Saturated Condition

GRID	ANGLE OF FRICTION UNDER NORMAL STRESS (°)				
	T1	T2	T3	T4	T5
Mean($\bar{x}$)	**46.44**	**29.14**	**24.82**	**16.83**	**14.77**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i-\bar{x})^2}$	**0.046**	**0.082**	**0.181**	**0.020**	**0.164**

Table 4.31 Mean Angle of Friction Data for Kade (0-15cm) under Unsaturated Condition

GRID	ANGLE OF FRICTION UNDER NORMAL STRESS (°)				
	T1	T2	T3	T4	T5
Mean($\bar{x}$)	**22.87**	**3.34**	**4.76**	**1.58**	**4.27**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i - \bar{x})^2}$	**0.447**	**0.177**	**0.168**	**0.053**	**0.113**

Table 4.32 Mean Angle of Friction Data for Kpong (0-15cm) under Unsaturated Condition

GRID	ANGLE OF FRICTION UNDER NORMAL STRESS (°)				
	T1	T2	T3	T4	T5
Mean($\bar{x}$)	**63.67**	**47.69**	**29.60**	**24.95**	**17.91**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i - \bar{x})^2}$	**0.032**	**0.025**	**0.046**	**0.020**	**0.030**

Table 4.33 Mean Angle of Friction Data for Kade (15-30cm) under Unsaturated Condition

GRID	ANGLE OF FRICTION UNDER NORMAL STRESS (°)				
	T1	T2	T3	T4	T5
Mean($\bar{x}$)	**14.07**	**15.87**	**2.63**	**3.24**	**1.33**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i - \bar{x})^2}$	**1.049**	**0.669**	**0.138**	**0.391**	**0.234**

Table 4.34 Mean Angle of Friction Data for Kpong (15-30cm) under Unsaturated Condition

GRID	ANGLE OF FRICTION UNDER NORMAL STRESS (°)				
	T1	T2	T3	T4	T5
Mean($\bar{x}$)	**44.22**	**25.47**	**4.72**	**5.71**	**4.68**
Standard Dev. (σ)= $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(D_i-\bar{x})^2}$	**0.037**	**0.077**	**0.40**	**0.031**	**0.015**

Plots of mean angle of friction values against normal stress for Kade and Kpong under saturated and unsaturated conditions are presented in appendix C. It was observed that angle of friction decreased with increasing normal stress under saturated and unsaturated conditions at both Kade and Kpong.

4.5 Analysis of variance (ANOVA)

The ANOVA results with Confidence Interval (CI) of 95% and a set alpha value of 0.05 shows that all the p-values (0.01) were lesser than the set alpha values an indication that there is a significant effect of normal stress on shear stress, cohesion and angle of friction where null hypothesis is the n=1 (i.e. there is a significant effect of normal stress on shear stress, cohesion and angle of friction). It can, therefore, be inferred that the normal stress has a highly significant ($p \leq 0.05$) effect on the shear, cohesion and angle of friction of the soil. This, therefore, supports the claims that change in normal stress has an effect on the shear, cohesion and angle of friction of a soil. A sample of the results are presented in tables 4.35-4.37 the rest are found in the appendix.

Table 4.35 Results of Analysis of Variance Test for Shear Stress of Kade 0-15cm Saturated

Variate: SHEAR

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	2.805E+00	7.012E-01	84517.11	<.001
Residual	120	9.956E-04	8.297E-06		
Total	124	2.806E+00			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

From the results (Table 4.51) the p-value (0.01) is less than the alpha value (0.05), which supports the claim by Jury & Stolzy (2018) that increase in normal stress increases soil strength.

Table 4.36 Results of Analysis of Variance Test for Cohesion of Kade 0-15cm Saturated

Variate: COHESION

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	1.76061657	0.44015414	17195.17	<.001
Residual	120	0.00307171	0.00002560		
Total	124	1.76368827			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

From the results (Table 3.46), the p-value (0.01) is less than the alpha value (0.05), which supports the claim by Jury & Stolzy (2018) that increase in normal stress increases cohesion.

Table 4.37 Results of Analysis of Variance Test for Angle of friction of Kade 0-15cm Saturated

Variate: ANGLE OF FRICTION

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	204.46357	51.11589	1877.62	<.001
Residual	120	3.26685	0.02722		
Total	124	207.73041			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

From the results (Table 4.37), the p-value (0.01) is less than the alpha value (0.05), thus it supports the claim by Ruiz & Schymanski (2015) that increase in normal stress decreases the angle of friction.

In general, for the ANOVA results, similar interpretation was obtained for the rest of the samples of Kade and Kpong soils which will be found in Appendix C.

4.6 Effects of shears, cohesion and angle of friction on trafficability, traction, foundation, performance of implement and root growth.

As increase in normal stress results in increased shear stress and cohesion but reduction in the angle of friction, it is vital for farm operators and managers to take note of the weight of implement and its impact on the soils that they are engaged with. A heavy implement or heavy duty works that will be done on the land has a greater chance of compacting the soil (reduction in the air spaces). This becomes beneficial if the soil will be used for structures, dams and also foundation structures since it will increase the strength of the soil (the bearing capacity) once the soil is well drained. A disadvantage will be the impediment to root growth, and hydraulic conductivity which

in the long round can cause flooding ~~to~~ when water is not able to sip through the soil during irrigation.

The stronger the soil, the higher the cohesion which also reduces slippage but extremely higher shear or cohesion can cause slippage of tractive device, that is, if it is rubber. This also has an effect on the efficiency of farm machinery because the slippage causes a loss of energy. A stronger soil will drain to make trafficability easier (Adekalu et al., 2007 A).

Simalenga and Have (1994), stated the following factors make trafficability possible on the soil:

a. It has significant compressive strength to withstand the weight of the machinery.
b. It has significant shear strength to meet the traction requirement with acceptable wheel slip and soil damage and
c. A suitable soil tilth can be produced

The draft force, field capacity, as well, as aggregation of farm machinery for tillage purpose is dependent on the strength of the soil. The stronger the soil the greater the draft force required, the higher the field capacity of machinery required and also requires more revenue and effective planning (Adekalu et al., 2007).

In other terms, the strength of soil determines the design the implement used for tillage, and the type of foundation for a structure.

CHAPTER 5

5 CONCLUSIONS AND RECOMMENDATION

The experiments presented in this study were intended to determine some engineering parameters (constants) of the soils at Kade and Kpong. As well as the effect these properties independently have on tillage, trafficability, foundation, root growth and extension, traction and tractive devices. The main conclusion is as follows;

- Results from experimental study showed that moisture content reduced as normal stress increased.
- It is established from the study that not only average shear stress and cohesion increased as normal stress but the angle of friction decreased as normal stress increased.
- Kade soil has a lower shear stress as compared to the Kpong soil.
- Plasticity Index of Kade soil is lower than that of Kpong soil at all depth. This implies higher clay content in Kpong than Kade soil.

From the results obtained, the objective of this study and deductions made, the shear stress, cohesion and angle of friction showed how normal stress has effect on them.

Due to the findings that the properties portray in the soil, the following recommendations are made on the soils respectively in relation to its potential use to serve as a guide in the selection of implements (aggregates), bearing ability or trafficability of the soil;

- A surcharge or weight or load must be placed at the area where a structure is needed to be built to reduce moisture content as well as increase the bearing ability of soil. Sand and vertical drains can also be constructed in the reduction of moisture on the land.

- The Kpong soil is adequate for canals for dams and irrigation as compared to Kade soil due to its high water retaining ability. In addition, the Kpong soil due to its high clay content will support irrigated agriculture, especially for rice production.

- Tractive devices that are effective for Kpong soil is a crawler or rubber tires with bigger and deeper threads making it trafficable when saturated as Simalenga and Have (1994) states for a trafficable soil.
- The draft required on the Kpong soil must be higher than that of the Kade soil for effective tillage operation (Adekalu et al., 2007 A).

- The suitable crops for Kpong soil is mostly crops that do so well in a soil that is high in clay such as rice which Kade require crops like vegetables, maize and tuber.

- It is also suggested that, further determination of other parameters in relation with this outcome to establish the universality of these strength parameters.

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APPENDIX

APPENDIX A

RAW DATA ON LIQUID LIMIT AND PLASTICITY INDEX FOR INDIVIDUAL GRIDS FOR KADE AND KPONG SOILS

KADE

GRID 1

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	20.2	9.5	24.3	9.8
2	23.5	11.3	22.4	10.8
3	19.5	10.6	25.8	11.8
4	22.3	11.3	22.4	12.5
5	20.5	8.6	21.5	10.9
AVERAGE	**21.2**	**10.26**	**23.28**	**11.16**

GRID 2

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	22.3	10.1	21.5	10.9
2	21.5	11.3	23.6	9.8
3	20.3	10.6	22.4	8.5
4	19.4	9.4	19.5	11.2
5	18.5	8.6	24.6	9.6
AVERAGE	**20.4**	**10**	**22.32**	**10.0**

GRID 3

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	20.3	8.3	25.6	9.1
2	19.5	9.2	22.4	10.9
3	17.3	8.9	19.2	8.5
4	23.2	10.2	23.6	9.2
5	20.1	11.3	22.8	8.9
AVERAGE	**20.08**	**9.58**	**22.72**	**9.32**

GRID 4

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	24.0	11.4	19.2	9.0
2	18.2	8.7	24.1	8.7
3	19.1	9.2	25.9	10.9
4	20.5	10.1	20.3	9.5
5	23.4	12.0	22.4	10.9
AVERAGE	**21.04**	**10.28**	**22.38**	**9.8**

GRID 5

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	19.8	10.2	20.3	9.8
2	24.1	9.5	21.5	10.9
3	18.6	12.5	23.6	11.5
4	20.1	10.4	25.5	9.5
5	22.3	11.3	23.4	8.7
AVERAGE	**20.98**	**10.78**	**22.86**	**10.08**

GRID 6

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	22.3	10.3	24.9	11.5
2	19.2	9.5	23.1	9.5
3	23.1	11.2	22.4	10.2
4	18.0	11.3	20.8	8.7
5	20.5	12.5	21.5	10.9
AVERAGE	**20.62**	**10.96**	**22.54**	**10.16**

GRID 7

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	19.1	12.6	19.1	9.4
2	20.5	10.3	22.4	11.1
3	23.4	11.3	25.1	9.9
4	22.3	9.5	22.7	8.7
5	19.2	8.7	18.4	10.5
AVERAGE	**20.9**	**10.48**	**21.54**	**9.92**

GRID 8

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	20.2	10.1	19.2	9.8
2	23.5	11.3	23.6	10.9
3	18.5	12.1	20.4	11.5
4	17.9	9.4	21.5	10.1
5	19.6	8.6	25.8	8.7
AVERAGE	**19.94**	**10.3**	**22.1**	**10.2**

GRID 9

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	21.4	10.2	19.2	10.9
2	19.5	9.5	21.0	9.8
3	18.2	12.2	22.4	8.5
4	23.2	10.1	22.3	11.2
5	20.1	11.6	21.5	9.6
AVERAGE	**20.48**	**10.72**	**21.28**	**10.0**

GRID 10

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	20.5	11.4	19.6	10.9
2	18.6	8.7	22.3	9.4
3	20.1	9.2	19.1	8.5
4	17.8	10.1	20.3	11.6
5	22.9	12.0	23.6	9.6
AVERAGE	**19.98**	**10.28**	**20.98**	**10.0**

GRID 11

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	23.2	8.3	22.1	9.0
2	22.1	9.2	24.1	8.7
3	18.5	8.9	17.6	10.9
4	19.8	10.2	18.6	9.5
5	20.5	11.3	20.3	10.9
AVERAGE	**20.82**	**9.58**	**20.54**	**9.8**

GRID 12

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	23.9	10.2	23.6	9.8
2	18.6	9.5	18.2	10.9
3	20.1	12.5	19.6	11.2
4	19.5	10.4	22.5	9.5
5	23.4	11.3	23.1	8.2
AVERAGE	**21.1**	**10.78**	**21.4**	**9.92**

GRID 13

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	19.8	10.3	20.3	11.1
2	24.1	9.5	21.5	9.8
3	18.6	11.2	23.6	8.3
4	20.1	11.3	20.8	11.2
5	22.3	12.5	22.4	9.2
AVERAGE	**20.98**	**10.96**	**21.72**	**9.92**

GRID 14

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	19.8	8.3	22.9	9.4
2	24.1	9.2	22.4	11.3
3	18.6	8.4	19.2	9.6
4	20.1	10.5	17.6	8.3
5	22.3	11.6	21.2	10.5
AVERAGE	**20.98**	**9.6**	**20.66**	**9.82**

GRID 15

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	21.4	10.1	21.5	9.4
2	19.5	11.3	23.6	11.1
3	18.2	10.6	22.4	9.9
4	23.2	9.4	19.5	8.7
5	20.1	8.6	20.5	10.5
AVERAGE	**20.48**	**10.0**	**21.5**	**9.92**

GRID 16

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	22.5	8.3	20.6	10.9
2	19.3	9.2	22.4	9.4
3	17.9	8.9	20.1	8.5
4	23.0	10.2	22.4	11.6
5	21.0	11.3	21.5	9.6
AVERAGE	**20.74**	**9.58**	**21.4**	**10**

GRID 17

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	24.0	11.2	19.6	9.6
2	18.2	8.7	22.3	11.5
3	20.1	9.3	19.1	9.1
4	19.5	10.2	20.3	8.3
5	23.4	12.0	22.6	10.5
AVERAGE	**21.04**	**10.28**	**20.78**	**9.8**

GRID 18

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	20.2	12.6	22.1	10.9
2	23.5	10.3	22.4	9.8
3	19.5	11.3	17.6	8.5
4	22.3	9.5	18.6	11.2
5	20.5	8.7	20.3	9.6
AVERAGE	**21.2**	**10.48**	**20.2**	**10.0**

GRID 19

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	19.8	10.3	25.9	11.2
2	24.1	9.5	23.6	9.4
3	18.6	11.2	22.4	8.2
4	20.1	11.3	19.5	11.6
5	22.3	12.5	20.5	9.6
AVERAGE	**20.98**	**10.96**	**22.38**	**10.0**

GRID 20

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	18.7	9.5	20.5	9.4
2	19.8	11.3	22.4	11.3
3	22.3	10.6	19.2	10.1
4	20.1	11.3	23.8	8.7
5	23.5	8.6	21.2	10.5
AVERAGE	**20.88**	**10.26**	**21.42**	**10.0**

GRID 21

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	19.8	10.1	20.6	9.4
2	24.1	11.3	22.4	12.1
3	18.6	10.6	20.1	10.1
4	20.1	9.4	22.4	8.5
5	22.3	8.6	21.5	11.5
AVERAGE	**20.98**	**10.0**	**21.4**	**10.32**

GRID 22

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	24.0	10.3	21.5	10.0
2	18.2	9.5	23.6	11.9
3	19.1	11.2	22.4	9.7
4	20.5	11.3	19.5	8.5
5	23.4	12.5	20.5	10.9
AVERAGE	**21.04**	**10.96**	**21.5**	**10.2**

GRID 23

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	19.8	12.6	18.7	9.1
2	24.1	10.3	22.4	10.9
3	18.6	11.3	19.6	8.5
4	20.1	9.5	22.4	9.2
5	22.3	8.7	22.4	8.9
AVERAGE	**20.98**	**10.48**	**21.1**	**9.32**

GRID 24

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	20.1	8.3	22.1	9.8
2	19.8	9.2	22.4	10.8
3	18.6	8.9	17.6	11.8
4	21.6	10.2	18.6	12.5
5	22.3	11.3	20.3	10.9
AVERAGE	**20.48**	**9.58**	**20.2**	**11.16**

GRID 25

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	24.0	9.5	20.6	11.1
2	18.2	11.3	22.4	9.8
3	19.1	10.6	20.1	8.3
4	20.5	11.3	22.4	11.2
5	23.4	8.6	21.5	9.2
AVERAGE	**21.04**	**10.26**	**21.4**	**9.92**

KPONG

GRID 1

0-15 CM			15-30 CM	
REPLICATES	LL	PL	LL	PL
1	20.4	9.5	30.5	7.2
2	23.5	10.3	28.5	10.4
3	23.5	11.5	27.8	9.5
4	25.2	8.9	25.6	8.0
5	23.6	11.2	20.5	10.4
AVERAGE	**23.24**	**10.28**	**26.58**	**9.1**

GRID 2

0-15 CM			15-30 CM	
REPLICATES	LL	PL	LL	PL
1	27.2	10.3	32.2	9.5
2	26.3	9.5	25.5	10.4
3	25.2	11.3	31.1	12.0
4	24.6	8.5	30.1	9.5
5	21.5	9.8	28.5	10.4
AVERAGE	**24.96**	**9.88**	**29.48**	**10.36**

GRID 3

0-15 CM			15-30 CM	
REPLICATES	LL	PL	LL	PL
1	25.2	11.5	31.1	9.5
2	22.1	8.9	25.2	10.4
3	26.1	8.5	27.1	12.0
4	21.5	8.5	24.9	9.5
5	25.2	10.3	32.1	9.8
AVERAGE	**24.02**	**9.54**	**28.08**	**10.24**

GRID 4

0-15 CM			15-30 CM	
REPLICATES	LL	PL	LL	PL
1	22.0	8.9	30.2	9.1
2	25.2	8.5	25.5	10.4
3	22.1	10.3	31.2	12.7
4	24.2	8.6	28.7	10.2
5	21.5	10.3	33.1	9.4
AVERAGE	**23.00**	**9.32**	**29.74**	**10.36**

GRID 5

0-15 CM			15-30 CM	
REPLICATES	LL	PL	LL	PL
1	24.4	9.8	31.2	12.3
2	25.2	10.3	25.2	9.2
3	27.2	11.5	33.5	9.8
4	26.5	8.6	25.1	11.5
5	24.0	12.5	30.2	10.4
AVERAGE	**25.46**	**10.54**	**29.04**	**10.64**

GRID 6

0-15 CM			15-30 CM	
REPLICATES	LL	PL	LL	PL
1	27.1	10.3	31.1	11.5
2	24.6	12.5	31.2	12.7
3	26.9	11.5	28.7	10.2
4	25.2	9.6	33.5	9.4
5	23.9	8.5	25.1	10.1
AVERAGE	**25.54**	**10.48**	**29.92**	**10.78**

GRID 7

0-15 CM			15-30 CM	
REPLICATES	LL	PL	LL	PL
1	25.2	11.2	30.2	11.5
2	22.1	9.3	25.5	9.5
3	26.9	10.3	33.5	10.4
4	25.2	8.7	26.3	12.7
5	25.2	12.1	31.5	10.2
AVERAGE	**24.92**	**10.32**	**29.40**	**10.86**

GRID 8

0-15 CM			15-30 CM	
REPLICATES	LL	PL	LL	PL
1	23.6	11.5	31.2	8.6
2	25.2	8.9	25.2	9.6
3	26.3	9.3	33.5	11.2
4	24.1	8.5	25.1	12.3
5	22.2	10.6	30.2	10.4
AVERAGE	**24.28**	**9.76**	**29.04**	**10.42**

GRID 9

0-15 CM			15-30 CM	
REPLICATES	LL	PL	LL	PL
1	26.1	11.2	30.5	12.1
2	22.5	9.8	28.5	10.3
3	25.2	8.5	27.8	9.6
4	23.8	12.3	25.6	8.7
5	24.9	9.1	20.5	11.1
AVERAGE	**24.50**	**10.18**	**26.58**	**10.36**

GRID 10

0-15 CM			15-30 CM	
REPLICATES	LL	PL	LL	PL
1	25.8	12.0	30.5	11.2
2	24.6	11.6	31.2	12.6
3	22.3	9.6	28.7	9.2
4	21.5	10.1	33.5	8.5
5	26.0	9.8	25.1	10.4
AVERAGE	**24.04**	**10.62**	**29.80**	**10.38**

GRID 11

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	24.6	10.3	31.2	11.2
2	23.1	8.7	25.2	9.5
3	22.5	9.6	33.5	9.1
4	21.5	11.2	25.1	8.6
5	25.6	12.6	30.2	10.4
AVERAGE	**23.46**	**10.48**	**29.04**	**9.76**

GRID 12

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	26.4	10.3	30.2	10.1
2	23.1	9.5	28.5	8.2
3	24.5	11.3	27.8	9.4
4	25.2	8.5	25.6	12.1
5	22.3	9.8	20.5	11.2
AVERAGE	**24.30**	**9.88**	**26.52**	**10.20**

GRID 13

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	24.4	11.2	31.2	9.5
2	25.2	9.5	26.1	12.5
3	27.2	8.3	30.1	11.6
4	26.5	9.6	25.1	9.2
5	24.0	10.6	32.1	10.4
AVERAGE	**25.46**	**9.84**	**28.92**	**10.64**

GRID 14

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	21.6	8.9	30.2	10.2
2	24.3	8.5	31.2	8.5
3	26.1	10.3	28.2	9.6
4	25.8	8.6	26.3	9.2
5	22.5	9.3	32.5	12.5
AVERAGE	**24.06**	**9.12**	**29.68**	**10.00**

GRID 15

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	24.4	12.6	30.5	10.4
2	25.2	9.6	31.2	10.2
3	27.2	11.5	28.7	11.5
4	26.5	8.9	33.5	12.1
5	24.0	10.3	25.1	9.1
AVERAGE	**25.46**	**10.58**	**29.80**	**10.66**

GRID 16

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	25.2	11.2	25.6	9.5
2	22.1	8.6	31.2	11.2
3	26.1	7.8	30.2	12.0
4	21.5	9.2	27.1	8.1
5	24.9	12.3	26.5	9.8
AVERAGE	**23.96**	**9.82**	**28.12**	**10.12**

GRID 17

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	26.1	10.5	30.5	10.2
2	22.1	9.6	31.2	11.2
3	25.9	12.6	28.7	9.8
4	21.5	8.9	33.5	8.1
5	25.2	11.2	25.1	9.1
AVERAGE	**24.16**	**10.56**	**29.80**	**9.68**

GRID 18

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	24.4	9.3	30.5	11.2
2	25.2	10.2	28.5	9.2
3	27.2	11.3	27.8	9.8
4	26.5	8.5	25.6	12.2
5	24.0	9.8	20.5	10.4
AVERAGE	**25.46**	**9.82**	**26.58**	**10.56**

GRID 19

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	26.5	9.5	30.2	11.2
2	24.6	8.6	26.3	8.5
3	25.1	11.5	31.2	9.3
4	22.3	9.2	28.7	8.7
5	24.8	10.2	33.1	12.2
AVERAGE	**24.66**	**9.80**	**29.90**	**9.98**

GRID 20

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	26.8	11.2	30.2	11.3
2	24.0	9.3	25.5	9.6
3	25.2	10.3	31.2	10.5
4	23.6	8.7	28.7	12.1
5	21.9	12.1	33.1	9.1
AVERAGE	**24.30**	**10.32**	**29.74**	**10.52**

GRID 21

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	20.4	8.9	30.2	11.2
2	23.5	9.1	25.5	9.3
3	23.5	12.6	31.2	10.2
4	25.2	9.6	28.7	8.4
5	23.6	10.2	33.1	12.1
AVERAGE	**23.24**	**10.08**	**29.74**	**10.24**

GRID 22

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	26.3	9.5	30.2	10.3
2	24.5	10.3	25.5	9.5
3	22.8	11.5	31.2	11.3
4	24.9	8.9	28.7	8.4
5	22.4	11.2	33.1	11.3
AVERAGE	**24.18**	**10.28**	**29.74**	**10.16**

GRID 23

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	24.4	8.9	30.2	9.4
2	25.2	7.8	25.8	10.6
3	27.2	11.5	32.1	12.3
4	26.5	9.6	27.8	11.6
5	24.0	10.3	31.3	9.1
AVERAGE	**25.46**	**9.62**	**29.44**	**10.60**

GRID 24

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	25.2	9.6	30.2	12.2
2	26.5	12.5	25.5	9.8
3	22.3	8.9	31.2	11.5
4	24.8	9.2	28.7	9.6
5	22.9	10.1	33.1	10.3
AVERAGE	**24.34**	**10.06**	**29.74**	**10.68**

GRID 25

0-15 CM			15-30 CM	
REPLICATES	**LL**	**PL**	**LL**	**PL**
1	20.4	8.9	32.2	9.1
2	23.5	7.8	26.3	10.4
3	23.5	10.3	27.1	12.7
4	25.2	8.6	30.1	10.2
5	23.6	10.5	28.5	9.4
AVERAGE	**23.24**	**9.22**	**28.84**	**10.36**

APPENDIX B
SHEAR MEASUREMENTS
RAW DATA ON SHEAR FOR INDIVIDUAL GRIDS FOR KADE SOIL 0-15 CM SATURATED

GRID	1					2				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.2123	0.3615	0.4245	0.5651	0.6432	0.2254	0.3711	0.4451	0.5611	0.6432
2	0.2310	0.3701	0.4231	0.5712	0.6512	0.2246	0.3615	0.4221	0.5589	0.639
3	0.2210	0.362	0.424	0.5621	0.661	0.2109	0.3611	0.4235	0.5741	0.6389
4	0.2130	0.3591	0.4239	0.5523	0.6458	0.2123	0.3609	0.422	0.5541	0.643
5	0.2125	0.3612	0.4301	0.5614	0.6601	0.2312	0.3585	0.4215	0.562	0.661

GRID	3					4				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.2316	0.3611	0.4231	0.5518	0.6458	0.2261	0.3615	0.4328	0.5621	0.6432
2	0.2531	0.3618	0.4251	0.5702	0.6601	0.2236	0.3622	0.4231	0.5621	0.6501
3	0.2231	0.371	0.4321	0.5677	0.6432	0.2229	0.3587	0.4285	0.5523	0.6623
4	0.2153	0.3622	0.432	0.5712	0.6512	0.2119	0.3612	0.4235	0.5614	0.661
5	0.2125	0.3711	0.4321	0.5651	0.6623	0.2312	0.3701	0.4325	0.5611	0.639

GRID	5					6				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.2151	0.362	0.424	0.5589	0.6389	0.2254	0.3611	0.424	0.5621	0.6432
2	0.2464	0.3591	0.4239	0.5741	0.643	0.2241	0.3609	0.4239	0.5523	0.6512
3	0.2136	0.3612	0.4301	0.5621	0.661	0.2119	0.3701	0.4301	0.5614	0.6623
4	0.2214	0.3711	0.4451	0.5523	0.6458	0.2123	0.362	0.4451	0.5611	0.6432
5	0.2125	0.3615	0.4221	0.5614	0.6601	0.2200	0.3701	0.4221	0.5589	0.6501

GRID	7					8				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.2146	0.362	0.4235	0.5741	0.6623	0.2245	0.3611	0.4239	0.5589	0.6432
2	0.2531	0.3591	0.422	0.5541	0.661	0.2131	0.3609	0.4301	0.5614	0.6508
3	0.2231	0.3612	0.4215	0.562	0.6458	0.2227	0.3585	0.4451	0.5611	0.6512
4	0.2123	0.3711	0.4231	0.5614	0.6601	0.2139	0.3611	0.4221	0.5589	0.639
5	0.2130	0.3615	0.424	0.5611	0.6432	0.2312	0.3618	0.4235	0.5741	0.6389

GRID	9					10				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.2228	0.371	0.422	0.5541	0.643	0.2252	0.3611	0.4301	0.5611	0.6512
2	0.2538	0.3591	0.4215	0.562	0.661	0.2208	0.3609	0.424	0.5589	0.6623
3	0.2137	0.3612	0.4231	0.5518	0.6458	0.2219	0.3585	0.4239	0.5741	0.6432
4	0.2231	0.3711	0.424	0.5702	0.6601	0.2214	0.3701	0.4301	0.5541	0.6501
5	0.2301	0.3615	0.4239	0.5677	0.6432	0.2312	0.362	0.4451	0.562	0.6623

GRID	11					12				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.2214	0.3591	0.4221	0.5518	0.661	0.2254	0.3591	0.4251	0.5456	0.6432
2	0.2530	0.3612	0.4235	0.5702	0.6458	0.2236	0.3612	0.4321	0.5651	0.6432
3	0.2251	0.3711	0.422	0.5677	0.6601	0.2231	0.3701	0.4221	0.5712	0.6512
4	0.2315	0.3701	0.4215	0.5523	0.6432	0.2123	0.362	0.4235	0.5651	0.661
5	0.2125	0.362	0.4231	0.5614	0.6432	0.2312	0.3591	0.422	0.5621	0.6458

GRID	13					14				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.2123	0.3612	0.4215	0.5523	0.6601	0.2254	0.3585	0.4412	0.5651	0.661
2	0.2531	0.3711	0.4231	0.5614	0.6432	0.2236	0.3611	0.4325	0.5621	0.6458
3	0.2123	0.3615	0.4251	0.5456	0.6512	0.2231	0.3618	0.4245	0.5523	0.6601
4	0.2123	0.3611	0.4321	0.5651	0.6432	0.2123	0.371	0.4231	0.5614	0.6432
5	0.2125	0.3609	0.4451	0.5712	0.6512	0.2312	0.3625	0.4245	0.5456	0.6512

GRID	15					16				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.2123	0.3615	0.4451	0.5523	0.6623	0.2254	0.3622	0.4245	0.5621	0.6432
2	0.2531	0.3622	0.4325	0.5621	0.6432	0.2236	0.3625	0.4231	0.5523	0.6432
3	0.2087	0.3625	0.4325	0.5651	0.6432	0.2227	0.3615	0.4245	0.5614	0.6512
4	0.2123	0.3614	0.4326	0.5712	0.6623	0.2123	0.3622	0.4451	0.5456	0.661
5	0.2125	0.3591	0.4226	0.5651	0.6432	0.2312	0.3625	0.4325	0.5651	0.6458

GRID	17					18				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.2123	0.3614	0.4325	0.5712	0.6601	0.2254	0.3622	0.4325	0.5456	0.661
2	0.2531	0.3591	0.4245	0.5651	0.6432	0.2225	0.3625	0.4325	0.5523	0.6458
3	0.2087	0.3615	0.4231	0.5621	0.6512	0.2231	0.3615	0.4326	0.5651	0.6601
4	0.2123	0.3654	0.4245	0.5523	0.6432	0.2123	0.3622	0.4226	0.5712	0.6432
5	0.2125	0.3615	0.4451	0.5614	0.6512	0.2312	0.3625	0.4351	0.5651	0.6512

GRID	19					20				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.2530	0.3614	0.4245	0.5621	0.6623	0.2315	0.3615	0.4226	0.5614	0.6432
2	0.2251	0.3591	0.4231	0.5523	0.6432	0.2125	0.3622	0.4245	0.5456	0.661
3	0.2312	0.3615	0.4245	0.5614	0.6432	0.2087	0.3625	0.4231	0.5523	0.6458
4	0.2123	0.3622	0.4451	0.5456	0.6623	0.2123	0.3614	0.4245	0.5651	0.6601
5	0.2531	0.3625	0.4325	0.5523	0.6432	0.2125	0.3591	0.4451	0.5712	0.6432

GRID	21					22				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.2254	0.3615	0.4321	0.5651	0.6458	0.2254	0.3615	0.422	0.5523	0.6601
2	0.2087	0.3654	0.4221	0.5621	0.6623	0.2087	0.3622	0.4215	0.5621	0.6584
3	0.2123	0.3615	0.4235	0.5523	0.6512	0.2123	0.3625	0.4231	0.5584	0.6432
4	0.2204	0.3622	0.422	0.5614	0.661	0.2125	0.3614	0.4251	0.5651	0.6512
5	0.2216	0.3625	0.4215	0.5456	0.6458	0.2254	0.3591	0.4312	0.5712	0.661

GRID	23					24				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.2200	0.3615	0.4221	0.5651	0.6458	0.2254	0.3615	0.4451	0.5523	0.6512
2	0.2146	0.3654	0.4235	0.5621	0.6601	0.2236	0.3622	0.4325	0.5614	0.661
3	0.2531	0.3615	0.4351	0.5523	0.6432	0.2120	0.3625	0.4325	0.5456	0.6458
4	0.2231	0.3622	0.4326	0.5614	0.6512	0.2123	0.3614	0.4326	0.5523	0.6601
5	0.2123	0.3625	0.4226	0.5456	0.6432	0.2312	0.3591	0.4226	0.5651	0.6432

GRID	25				
DEPTH	0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5
1	0.2190	0.3615	0.4351	0.5712	0.6512
2	0.2531	0.3654	0.4245	0.5651	0.6623
3	0.2218	0.3615	0.4231	0.5621	0.6432
4	0.2123	0.3622	0.4245	0.5523	0.6432
5	0.2256	0.3625	0.4451	0.5614	0.6623

GRID	1					2				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.9124	1.2464	0.8415	0.7251	0.8751	0.8972	1.2564	0.8871	0.7254	0.8711
2	0.9119	1.2512	0.8541	0.7156	0.8254	0.9251	1.2655	0.8614	0.7200	0.8742
3	0.9151	1.2531	0.8774	0.7214	0.8321	0.9124	1.2546	0.8771	0.7254	0.8321
4	0.9100	1.2561	0.8512	0.7156	0.8451	0.9325	1.2538	0.8871	0.7189	0.8451
5	0.9117	1.2558	0.8541	0.7156	0.8629	0.9124	1.2531	0.8710	0.7241	0.8742

GRID	3					4				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.8991	1.2547	0.8541	0.7251	0.8751	0.8972	1.2561	0.8512	0.7214	0.8321
2	0.9132	1.2561	0.8774	0.7251	0.8254	0.9251	1.2548	0.8541	0.7156	0.8251
3	0.9145	1.2553	0.8512	0.7259	0.8321	0.9124	1.2655	0.8871	0.7218	0.8451
4	0.9121	1.2500	0.8871	0.7241	0.8451	0.9325	1.2546	0.8871	0.7254	0.8321
5	0.9115	1.2654	0.8614	0.7156	0.8751	0.9124	1.2538	0.8774	0.7200	0.8647

GRID	5	6

DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.9120	1.2531	0.8512	0.7254	0.8751	0.8972	1.2546	0..8778	0.7254	0.8321
2	0.9201	1.2547	0.8541	0.7189	0.8254	0.9251	1.2538	0.8871	0.7200	0.8711
3	0.9185	1.2561	0.8871	0.7241	0.8721	0.9124	1.2531	0.8541	0.7254	0.8742
4	0.9108	1.2500	0.8871	0.7251	0.8451	0.9325	1.2547	0.8774	0.7189	0.8321
5	0.9124	1.2655	0.8614	0.7227	0.8751	0.9124	1.2561	0.8512	0.7156	0.8451
GRID	7					8				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.8991	1.2538	0.8415	0.7214	0.8742	0.8972	1.2531	0.8871	0.7254	0.8742
2	0.9132	1.2531	0.8541	0.7239	0.8751	0.9251	1.2549	0.8614	0.7189	0.8321
3	0.9145	1.2655	0.8774	0.7156	0.8254	0.9124	1.2562	0.8771	0.7211	0.8451
4	0.9100	1.2546	0.8512	0.7254	0.8321	0.9325	1.2538	0.8715	0.7251	0.8742
5	0.9124	1.2538	0.8541	0.7213	0.8711	0.9251	1.2541	0.8415	0.7241	0.8751

GRID	9					10				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.8972	1.2561	0.8541	0.7254	0.8254	0.9145	1.2538	0.8715	0.7215	0.8451
2	0.9251	1.2546	0.8774	0.7189	0.8321	0.9124	1.2542	0.8415	0.7156	0.8742
3	0.9124	1.2538	0.8512	0.7241	0.8711	0.8972	1.2561	0.8541	0.7214	0.8751
4	0.9325	1.2531	0.8541	0.7251	0.8742	0.9251	1.2545	0.8774	0.7239	0.8254
5	0.9251	1.2562	0.8771	0.7227	0.8321	0.9124	1.2538	0.8512	0.7156	0.8321

GRID	11	12
DEPTH	0-15 CM UNSAT	0-15 CM UNSAT

	NORMAL STRESS (kg/cm²)					NORMAL STRESS (kg/cm²)				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.9251	1.2541	0.8541	0.7254	0.8451	0.9201	1.2562	0.8541	0.7254	0.8742
2	0.9124	1.2552	0.8871	0.7213	0.8711	0.9185	1.2538	0.8774	0.7189	0.8751
3	0.9325	1.2546	0.8541	0.7227	0.8742	0.9108	1.2542	0.8512	0.7156	0.8254
4	0.9124	1.2538	0.8871	0.7254	0.8321	0.9128	1.2561	0.8541	0.7189	0.8321
5	0.8991	1.2531	0.8415	0.7200	0.8451	0.8972	1.2545	0.8871	0.7241	0.8451

GRID	13					14				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS (kg/cm²)					NORMAL STRESS (kg/cm²)				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.9201	1.2561	0.8541	0.7251	0.8751	0.9251	1.2538	0.8512	0.7200	0.8711
2	0.9185	1.2558	0.8871	0.7156	0.8321	0.9124	1.2531	0.8541	0.7254	0.8742
3	0.9108	1.2564	0.8415	0.7214	0.8251	0.9325	1.2547	0.8871	0.7189	0.8321
4	0.9124	1.2655	0.8541	0.7227	0.8751	0.9124	1.2561	0.8614	0.7156	0.8451
5	0.8972	1.2546	0.8774	0.7254	0.8321	0.8972	1.2558	0.8771	0.7241	0.8742

GRID	15					16				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS (kg/cm²)					NORMAL STRESS (kg/cm²)				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.9251	1.2564	0.8714	0.7251	0.8751	0.8972	1.2547	0.8541	0.7254	0.8742
2	0.9201	1.2655	0.8415	0.7156	0.8254	0.9400	1.2561	0.8415	0.7200	0.8321
3	0.9185	1.2546	0.8541	0.7214	0.8751	0.9100	1.2558	0.8541	0.7254	0.8451
4	0.9108	1.2538	0.8774	0.7156	0.8321	0.8972	1.2564	0.8774	0.7189	0.8742
5	0.9124	1.2531	0.8512	0.7156	0.8711	0.9251	1.2655	0.8512	0.7241	0.8751

GRID	17					18				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.9124	1.2546	0.8541	0.7251	0.8254	0.9325	1.2512	0.8614	0.7254	0.8321
2	0.9325	1.2538	0.8774	0.7156	0.8321	0.9127	1.2531	0.8541	0.7189	0.8251
3	0.8972	1.2531	0.8512	0.7227	0.8742	0.8991	1.2546	0.8774	0.7156	0.8321
4	0.9251	1.2547	0.8541	0.7254	0.8751	0.9132	1.2561	0.8512	0.7156	0.8751
5	0.9124	1.2561	0.8871	0.7200	0.8254	0.9124	1.2451	0.8541	0.7241	0.8321

GRID	19					20				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.9325	1.2539	0.8541	0.7251	0.8711	0.8972	1.2531	0.8541	0.7254	0.8751
2	0.9118	1.2564	0.8774	0.7156	0.8742	0.9251	1.2549	0.8774	0.7200	0.8751
3	0.8972	1.2566	0.8512	0.7214	0.8321	0.8977	1.2531	0.8512	0.7254	0.8321
4	0.9400	1.2464	0.8541	0.7156	0.8451	0.9251	1.2546	0.8541	0.7189	0.8711
5	0.9100	1.2512	0.8415	0.7156	0.8742	0.9124	1.2561	0.8871	0.7241	0.8742

GRID	21					22				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.9325	1.2451	0.8774	0.7200	0.8321	0.8711	1.2561	0.8512	0.7254	0.8711
2	0.9127	1.2538	0.8512	0.7254	0.8451	0.8742	1.2558	0.8415	0.7200	0.8742
3	0.8991	1.2542	0.8541	0.7189	0.8742	0.8321	1.2512	0.8541	0.7254	0.8321
4	0.9132	1.2561	0.8415	0.7241	0.8751	0.8451	1.2531	0.8774	0.7189	0.8451
5	0.9124	1.2545	0.8541	0.7218	0.8321	0.8742	1.2546	0.8512	0.7241	0.8742

GRID	23					24				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.9100	1.2546	0.8541	0.7251	0.8685	0.9117	1.2561	0.8489	0.7254	0.8321
2	0.9117	1.2558	0.8871	0.7227	0.8751	0.8972	1.2531	0.8541	0.7189	0.8451
3	0.8972	1.2512	0.8541	0.7156	0.8321	0.9251	1.2561	0.8774	0.7241	0.8742
4	0.9251	1.2531	0.8774	0.7254	0.8711	0.9100	1.2561	0.8512	0.7251	0.8751
5	0.9100	1.2542	0.8512	0.7200	0.8742	0.9117	1.2564	0.8541	0.7156	0.8751

GRID	25				
DEPTH	0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5
1	0.8972	1.2655	0.8871	0.7214	0.8321
2	0.9251	1.2464	0.8541	0.7156	0.8711
3	0.9124	1.2512	0.8541	0.7156	0.8742
4	0.9325	1.2531	0.8774	0.7254	0.8321
5	0.9124	1.2561	0.8512	0.7200	0.8451

GRID	1					2				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.8450	1.1254	1.6521	2.2123	2.5212	0.7910	1.1191	1.6509	2.1547	2.5218
2	0.7612	1.0945	1.6541	2.2211	2.5142	0.8641	1.1215	1.6521	2.2123	2.6112
3	0.7845	1.1217	1.6320	2.1985	2.4921	0.7900	1.1248	1.6325	2.2154	2.4917
4	0.8450	1.0972	1.6521	2.2145	2.6110	0.8450	1.1217	1.6414	2.2167	2.6110
5	0.8450	1.1254	1.6610	2.2250	2.4961	0.7994	1.0972	1.6521	2.2219	2.4921

GRID	3					4				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.8239	1.1254	1.6417	2.2178	2.6110	0.8302	1.1254	1.6610	2.2250	2.4961
2	0.8252	1.1191	1.6541	2.2217	2.4961	0.8314	1.1217	1.6541	2.1547	2.5218
3	0.8264	1.1215	1.6320	2.2211	2.5218	0.8327	1.0972	1.6320	2.2123	2.5142
4	0.8277	1.1248	1.6521	2.1985	2.4921	0.8340	1.1254	1.6521	2.2211	2.4921
5	0.8289	1.1254	1.6521	2.2145	2.6110	0.8352	1.1191	1.6610	2.1985	2.6110

GRID	5					6				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.8365	1.1191	1.6541	2.2145	2.4961	0.8427	1.1215	1.6521	2.1985	2.4921
2	0.8377	1.1215	1.6320	2.2250	2.5218	0.8440	1.1248	1.6521	2.2145	2.6110
3	0.8390	1.1248	1.6521	2.1547	2.6112	0.8452	1.1217	1.6417	2.2250	2.4961
4	0.8402	1.1217	1.6610	2.2123	2.4917	0.8465	1.0972	1.6509	2.1547	2.5218
5	0.8415	1.1191	1.6509	2.2211	2.5142	0.8478	1.1254	1.6521	2.2123	2.6112

GRID	7					8				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.8490	1.0972	1.6610	2.1547	2.5142	0.8553	1.1248	1.6320	2.1985	2.6112
2	0.8503	1.1254	1.6509	2.2123	2.4921	0.8565	1.1217	1.6521	2.2145	2.4917
3	0.8515	1.1191	1.6521	2.2211	2.6110	0.8578	1.1191	1.6509	2.2250	2.6110
4	0.8528	1.1191	1.6610	2.1985	2.4961	0.8590	1.1215	1.6521	2.1547	2.5142
5	0.8540	1.1215	1.6541	2.2211	2.5218	0.8603	1.1248	1.6325	2.2123	2.4921

GRID	9					10				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.8616	1.1254	1.6610	2.1985	2.6110	0.8678	1.1191	1.6610	2.2145	2.6110
2	0.8628	1.0945	1.6509	2.2145	2.4961	0.8691	1.1215	1.6509	2.2211	2.4921
3	0.8641	1.0972	1.6521	2.2250	2.5218	0.8703	1.1248	1.6521	2.1985	2.4961
4	0.8653	1.1254	1.6509	2.2211	2.6112	0.8716	1.0972	1.6509	2.2145	2.5218
5	0.8666	1.1191	1.6521	2.1985	2.4917	0.8728	1.1254	1.6521	2.2250	2.4917

GRID	11					12				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.8741	1.1191	1.6610	2.1547	2.6110	0.8804	1.0972	1.6521	2.1985	2.4921
2	0.8754	1.1191	1.6509	2.2123	2.4921	0.8816	1.1254	1.6509	2.2145	2.6110
3	0.8766	1.1215	1.6521	2.1985	2.6110	0.8829	1.1191	1.6521	2.2211	2.4961
4	0.8779	1.1248	1.6610	2.2135	2.4961	0.8841	1.2150	1.6521	2.1985	2.4917
5	0.8791	1.1217	1.6509	2.2211	2.5218	0.8854	1.1215	1.6417	2.2145	2.6110

GRID	13					14				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.8866	1.1248	1.6509	2.2211	2.4921	0.8929	1.1254	1.6521	2.2123	2.6110
2	0.8879	1.1217	1.6521	2.1985	2.6110	0.8942	1.1191	1.6521	2.1985	2.4961
3	0.8892	1.1191	1.6610	2.2145	2.4961	0.8954	1.0972	1.6417	2.2211	2.4917
4	0.8904	1.1215	1.6521	2.2250	2.5218	0.8967	1.1254	1.6509	2.1985	2.6110
5	0.8917	1.0972	1.6509	2.1547	2.4921	0.8979	1.1191	1.6521	2.2145	2.4921

GRID	15					16				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.8992	1.1191	1.6610	2.2250	2.6110	0.9055	1.2150	1.6509	2.2211	2.4921
2	0.9004	1.1215	1.6521	2.1547	2.4961	0.9067	1.1215	1.6521	2.1985	2.6110
3	0.9017	1.1248	1.6535	2.2211	2.5218	0.9080	1.1248	1.6541	2.2145	2.4961
4	0.9030	1.1217	1.6610	2.1985	2.4917	0.9092	1.1217	1.6320	2.2250	2.5218
5	0.9042	1.1191	1.6458	2.2145	2.6110	0.9105	1.1191	1.6538	2.1547	2.4921

GRID	17					18				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.9117	1.2150	1.6521	2.2211	2.4917	0.9180	1.1248	1.6521	2.2211	2.5218
2	0.9130	1.1215	1.6610	2.1985	2.6110	0.9193	1.1217	1.6509	2.1985	2.4921
3	0.9142	1.1248	1.6541	2.2145	2.4921	0.9205	1.1191	1.6521	2.2211	2.6110
4	0.9155	1.1217	1.6320	2.2250	2.6110	0.9218	1.2150	1.6610	2.1985	2.4961
5	0.9168	1.1191	1.6610	2.1547	2.4961	0.9230	1.1215	1.6509	2.2145	2.4917

GRID	19					20				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.9243	1.1248	1.6521	2.2250	2.6110	0.9306	1.1248	1.6521	2.2145	2.4921
2	0.9255	1.1217	1.6509	2.2211	2.4921	0.9318	1.1217	1.6541	2.1985	2.6110
3	0.9268	1.1191	1.6521	2.1985	2.6110	0.9331	1.1191	1.6541	2.2145	2.4961
4	0.9280	1.2150	1.6541	2.2211	2.4961	0.9343	1.2150	1.6320	2.2250	2.4917
5	0.9293	1.1215	1.6320	2.1985	2.5218	0.9356	1.1215	1.6521	2.2211	2.6110

GRID	21					22				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.9368	1.1248	1.6521	2.1985	2.4961	0.9431	1.1215	1.6521	2.2250	2.4921
2	0.9381	1.1215	1.6610	2.2145	2.5218	0.9444	1.2150	1.6541	2.2123	2.6110
3	0.9393	1.1248	1.6521	2.2250	2.4921	0.9456	1.1215	1.6320	2.2135	2.4917
4	0.9406	1.1217	1.6541	2.1985	2.6110	0.9469	1.1215	1.6521	2.1985	2.6110
5	0.9418	1.1191	1.6320	2.2145	2.6110	0.9481	1.1248	1.6521	2.2123	2.4921

GRID	23					24				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.9494	1.1217	1.8254	2.2123	2.6110	0.9556	1.0945	1.6521	2.2154	2.4921
2	0.9506	1.1191	1.6521	2.2145	2.4961	0.9569	1.1248	1.6541	2.2167	2.5212
3	0.9519	1.1215	1.6325	2.2250	2.5218	0.9582	1.1191	1.6320	2.2219	2.5142
4	0.9531	1.1191	1.6612	2.2211	2.4921	0.9594	1.1254	1.6542	2.1547	2.6110
5	0.9544	1.2150	1.6521	2.1985	2.5142	0.9607	1.1215	1.6521	2.2123	2.5142

GRID	25				
DEPTH	15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5
1	0.9619	1.1215	1.6385	2.2154	2.5142
2	0.9632	1.1248	1.6521	2.1547	2.4921
3	0.9644	1.1217	1.6325	2.2123	2.5212
4	0.9657	1.1191	1.6547	2.2154	2.5212
5	0.9669	1.1215	1.6521	2.2167	2.6110

GRID	1					2				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.5874	1.1954	0.9120	1.1524	1.1591	0.5854	1.2253	0.9197	1.1521	1.1581
2	0.6125	1.1591	0.9140	1.0568	1.1575	0.6101	1.2152	0.9187	1.1568	1.1591
3	0.5845	1.1601	0.9205	1.1485	1.1512	0.5864	1.2151	0.9179	1.1521	1.1586
4	0.5751	1.2152	0.9211	1.0491	1.1954	0.5648	1.1956	0.9175	1.1524	1.1574
5	0.5854	1.2151	0.9207	1.1521	1.1559	0.5645	1.2145	0.9120	1.0568	1.1578

GRID	3					4				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.5874	1.1954	0.9211	1.1485	1.1591	0.5854	1.2253	0.9120	1.0491	1.1581
2	0.6125	1.1591	0.9207	1.0491	1.1575	0.6101	1.2152	0.9140	1.1521	1.1591
3	0.5845	1.1601	0.9197	1.1524	1.1512	0.5864	1.2151	0.9205	1.1521	1.1586
4	0.5751	1.2152	0.9187	1.0568	1.1525	0.5648	1.1956	0.9211	1.1524	1.1574
5	0.5854	1.2151	0.9211	1.1485	1.1559	0.5645	1.2145	0.9207	1.0568	1.1578

GRID	5					6				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.5874	1.1954	0.9197	1.1485	1.1591	0.5854	1.2253	0.9120	1.1521	1.1581
2	0.6125	1.1591	0.9187	1.1524	1.1575	0.6101	1.2152	0.9140	1.1523	1.1591
3	0.5845	1.1601	0.9179	1.0568	1.1512	0.5864	1.2151	0.9205	1.1495	1.1586
4	0.5751	1.2152	0.9120	1.1485	1.1487	0.5648	1.1956	0.9211	1.1524	1.1574
5	0.5854	1.2151	0.9251	1.0491	1.1559	0.5645	1.2145	0.9207	1.0568	1.1578

GRID	7					8				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.5874	1.1954	0.9120	1.1485	1.1591	0.5854	1.2253	0.9197	1.0568	1.1581
2	0.6125	1.1591	0.9140	1.0491	1.1575	0.6101	1.2152	0.9187	1.1524	1.1591
3	0.5845	1.1601	0.9205	1.0568	1.1512	0.5864	1.2151	0.9120	1.0568	1.1586
4	0.5751	1.2152	0.9211	1.1485	1.1489	0.5648	1.1956	0.9140	1.1485	1.1574
5	0.5854	1.2151	0.9207	1.1524	1.1559	0.5645	1.2145	0.9205	1.0491	1.1578

GRID	9					10				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.5874	1.1954	0.9211	1.1524	1.1591	0.5854	1.2253	0.9205	1.1521	1.1581
2	0.6125	1.1591	0.9207	1.0568	1.1575	0.6101	1.2152	0.9211	1.1524	1.1591
3	0.5845	1.1601	0.9197	1.1485	1.1512	0.5864	1.2151	0.9207	1.0568	1.1586
4	0.5751	1.2152	0.9187	1.0491	1.1525	0.5648	1.1956	0.9197	1.1485	1.1574
5	0.5854	1.2151	0.9179	1.1521	1.1559	0.5645	1.2145	0.9187	1.0491	1.1578

GRID	11					12				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.5874	1.2253	0.9120	1.0568	1.1591	0.5854	1.1954	0.9197	1.1495	1.1581
2	0.6125	1.2152	0.9120	1.1485	1.1575	0.6101	1.1591	0.9205	1.1524	1.1591
3	0.5845	1.2151	0.9205	1.0491	1.1531	0.5864	1.1601	0.9211	1.0568	1.1586
4	0.5751	1.1956	0.9211	1.1521	1.1507	0.5648	1.2152	0.9207	1.1485	1.1574
5	0.5854	1.2145	0.9207	1.1523	1.1559	0.5645	1.2151	0.9197	1.0491	1.1578

GRID	13					14				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.5874	1.2253	0.9187	1.0568	1.1574	0.5854	1.1954	0.9207	1.0568	1.1487
2	0.6125	1.2152	0.9120	1.1485	1.1578	0.6101	1.1591	0.9197	1.1485	1.1559
3	0.5845	1.2151	0.9179	1.0568	1.1591	0.5864	1.1601	0.9187	1.0491	1.1581
4	0.5751	1.1956	0.9205	1.1485	1.1575	0.5648	1.2152	0.9120	1.1524	1.1591
5	0.5854	1.2145	0.9211	1.0491	1.1512	0.5645	1.2151	0.9179	1.0568	1.1512

GRID	15					16				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.5874	1.1956	0.9205	1.1485	1.1487	0.5854	1.2218	0.9120	1.0568	1.1581
2	0.6125	1.2145	0.9211	1.0491	1.1559	0.6101	1.2151	0.9197	1.1485	1.1591
3	0.5845	1.1954	0.9207	1.1521	1.1581	0.5864	1.2151	0.9187	1.0491	1.1586
4	0.5751	1.1591	0.9197	1.1521	1.1512	0.5648	1.1956	0.9120	1.1521	1.1574
5	0.5854	1.1601	0.9187	1.1524	1.1487	0.5645	1.2145	0.9124	1.1521	1.1578

GRID	17					18				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.5874	1.1954	0.9179	1.1521	1.1591	0.5854	1.2253	0.9211	1.0568	1.1574
2	0.6125	1.1591	0.9205	1.1521	1.1487	0.6101	1.2152	0.9207	1.1485	1.1591
3	0.5845	1.1601	0.9211	1.1523	1.1581	0.5864	1.2151	0.9197	1.0491	1.1586
4	0.5751	1.2152	0.9179	1.1495	1.1591	0.5648	1.1956	0.9187	1.1521	1.1574
5	0.5854	1.2151	0.9205	1.1524	1.1586	0.5645	1.2145	0.9179	1.1521	1.1578

GRID	19					20				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.5874	1.1954	0.9205	1.1521	1.1591	0.5854	1.2253	0.9197	1.0491	1.1574
2	0.6125	1.1591	0.9179	1.1521	1.1487	0.6101	1.2152	0.9187	1.1524	1.1591
3	0.5845	1.1601	0.9205	1.1524	1.1581	0.5864	1.2151	0.9120	1.0568	1.1586
4	0.5751	1.2152	0.9211	1.0568	1.1591	0.5648	1.1956	0.9187	1.1485	1.1574
5	0.5854	1.2151	0.9207	1.1485	1.1586	0.5645	1.2145	0.9179	1.0491	1.1578

GRID	21					22				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.5874	1.1954	0.9205	1.1521	1.1591	0.5854	1.2253	0.9120	1.0491	1.1591
2	0.6125	1.1591	0.9211	1.1521	1.1575	0.6101	1.2152	0.9179	1.1524	1.1586
3	0.5845	1.1601	0.9207	1.1524	1.1954	0.5864	1.2151	0.9205	1.0568	1.1574
4	0.5751	1.2152	0.9197	1.0568	1.1559	0.5648	1.1956	0.9211	1.1485	1.1578
5	0.5854	1.2151	0.9187	1.1485	1.1581	0.5645	1.2145	0.9207	1.0491	1.1591

GRID	23					24				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.5874	1.1954	0.9197	1.1524	1.1591	0.5854	1.2253	0.9211	1.0491	1.1578
2	0.6125	1.1591	0.9187	1.0568	1.1575	0.6101	1.2152	0.9207	1.1521	1.1591
3	0.5845	1.1601	0.9179	1.1485	1.1591	0.5864	1.2151	0.9197	1.1485	1.1586
4	0.5751	1.2152	0.9179	1.0568	1.1586	0.5648	1.1956	0.9187	1.0491	1.1574
5	0.5854	1.2151	0.9205	1.1485	1.1574	0.5645	1.2145	0.9179	1.1524	1.1578

GRID	25				
DEPTH	15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5
1	0.5874	1.1954	0.9205	1.1524	1.1591
2	0.6125	1.1591	0.9179	1.0568	1.1575
3	0.5845	1.1601	0.9205	1.1485	1.1512
4	0.5751	1.2152	0.9211	1.0491	1.1591
5	0.5854	1.2151	0.9251	1.1524	1.1586

SHEAR MEASUREMENTS
RAW DATA ON SHEAR FOR INDIVIDUAL GRIDS FOR KPONG SOIL

GRID	1					2				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.4517	0.5910	0.6125	0.7512	0.8817	0.4475	0.5892	0.6097	0.7523	0.8781
2	0.4620	0.5890	0.6120	0.7510	0.8900	0.4487	0.5890	0.6088	0.7515	0.8842
3	0.4520	0.5881	0.6117	0.7491	0.8821	0.4525	0.5881	0.6132	0.7509	0.8831
4	0.4491	0.5911	0.6119	0.7492	0.8825	0.4512	0.5911	0.6140	0.7541	0.8840
5	0.4521	0.5891	0.6142	0.7490	0.8831	0.4495	0.5891	0.6120	0.7511	0.8867

GRID	3					4				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.4481	0.5910	0.6119	0.7520	0.8817	0.4517	0.5872	0.6120	0.6897	0.8831
2	0.4521	0.5908	0.6142	0.7510	0.8842	0.4415	0.5891	0.6117	0.7515	0.8840
3	0.4520	0.5862	0.6097	0.7491	0.8867	0.4491	0.5881	0.6119	0.7612	0.8817
4	0.4475	0.5909	0.6088	0.7486	0.8825	0.4512	0.5911	0.6142	0.7511	0.8842
5	0.4428	0.5885	0.6125	0.7490	0.8860	0.4495	0.5891	0.6097	0.7489	0.8867

GRID	5					6				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.4481	0.5910	0.6088	0.7512	0.8825	0.4475	0.5892	0.6119	0.7512	0.8781
2	0.4521	0.5890	0.6134	0.7510	0.8831	0.4428	0.5890	0.6142	0.7510	0.8842
3	0.4520	0.5881	0.6125	0.7491	0.8781	0.4517	0.5872	0.6097	0.7491	0.8867
4	0.4491	0.5911	0.6120	0.7466	0.8825	0.4415	0.5891	0.6088	0.7486	0.8817
5	0.4521	0.5891	0.6117	0.7511	0.8831	0.4491	0.5881	0.6132	0.7511	0.8842
GRID	7					8				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.4521	0.5911	0.6140	0.7512	0.8867	0.4519	0.5909	0.6088	0.7511	0.8781
2	0.4475	0.5891	0.6120	0.7523	0.8825	0.4517	0.5910	0.6132	0.7512	0.8842
3	0.4487	0.5910	0.6119	0.7491	0.8860	0.4491	0.5892	0.6140	0.7510	0.8841
4	0.4525	0.5862	0.6142	0.7492	0.8825	0.4520	0.5910	0.6142	0.7491	0.8831
5	0.4521	0.5908	0.6097	0.7466	0.8831	0.4491	0.5891	0.6097	0.7486	0.8781

GRID	9					10				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.4521	0.5910	0.6088	0.6897	0.8842	0.4519	0.5891	0.6088	0.7523	0.8817
2	0.4620	0.5908	0.6132	0.7515	0.8867	0.4520	0.5910	0.6132	0.7491	0.8842
3	0.4520	0.5862	0.6140	0.7612	0.8817	0.4491	0.5892	0.6140	0.7492	0.8867
4	0.4491	0.5909	0.6120	0.7511	0.8842	0.4521	0.5910	0.6142	0.7466	0.8825
5	0.4521	0.5911	0.6119	0.7489	0.8867	0.4420	0.5891	0.6097	0.7511	0.8831

GRID	11					12				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.4517	0.5910	0.6120	0.7512	0.8781	0.4475	0.5891	0.6140	0.7466	0.8867
2	0.4620	0.5909	0.6132	0.7510	0.8842	0.4517	0.5910	0.6120	0.7515	0.8842
3	0.4520	0.5892	0.6097	0.7523	0.8867	0.4517	0.5908	0.6142	0.7513	0.8841
4	0.4491	0.5910	0.6088	0.7491	0.8817	0.4620	0.5910	0.6097	0.7492	0.8840
5	0.4521	0.5910	0.6132	0.7492	0.8842	0.4520	0.5891	0.6088	0.7490	0.8817

GRID	13					14				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.4491	0.5910	0.6132	0.7523	0.8831	0.4620	0.5891	0.6120	0.7542	0.8842
2	0.4521	0.5908	0.6140	0.7515	0.8781	0.4520	0.5909	0.6117	0.7515	0.8867
3	0.4475	0.5862	0.6120	0.7554	0.8842	0.4491	0.5911	0.6119	0.7492	0.8841
4	0.4525	0.5909	0.6097	0.7541	0.8867	0.4521	0.5891	0.6142	0.7490	0.8840
5	0.4517	0.5911	0.6088	0.7486	0.8817	0.4475	0.5910	0.6097	0.7523	0.8817

GRID	15					16				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.4517	0.5890	0.6120	0.7512	0.8817	0.4491	0.5891	0.6088	0.7511	0.8781
2	0.4491	0.5881	0.6117	0.7510	0.8900	0.4521	0.5910	0.6120	0.7515	0.8842
3	0.4517	0.5911	0.6119	0.7491	0.8821	0.4475	0.5908	0.6117	0.7482	0.8831
4	0.4620	0.5891	0.6142	0.7492	0.8825	0.4490	0.5862	0.6119	0.7491	0.8781
5	0.4520	0.5910	0.6097	0.7523	0.8831	0.4517	0.5909	0.6142	0.7492	0.8842

GRID	17					18				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.4620	0.5910	0.6097	0.7490	0.8867	0.4519	0.5910	0.6097	0.7519	0.8781
2	0.4520	0.5890	0.6088	0.7511	0.8817	0.4517	0.5891	0.6088	0.7492	0.8842
3	0.4491	0.5881	0.6088	0.7515	0.8842	0.4620	0.5911	0.6132	0.7523	0.8841
4	0.4521	0.5911	0.6156	0.7492	0.8867	0.4520	0.5891	0.6140	0.7490	0.8840
5	0.4475	0.5891	0.6142	0.7482	0.8831	0.4491	0.5890	0.6120	0.7511	0.8817

GRID	19					20				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.4521	0.5881	0.6142	0.7515	0.8817	0.4519	0.5910	0.6097	0.7491	0.8867
2	0.4475	0.5911	0.6097	0.7492	0.8900	0.4517	0.5892	0.6088	0.7515	0.8817
3	0.4520	0.5891	0.6088	0.7492	0.8831	0.4517	0.5910	0.6132	0.7482	0.8842
4	0.4491	0.5910	0.6132	0.7515	0.8781	0.4620	0.5908	0.6140	0.7491	0.8867
5	0.4521	0.5891	0.6140	0.7482	0.8842	0.4520	0.5886	0.6120	0.7492	0.8817

GRID	21					22				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.4491	0.5895	0.6097	0.7490	0.8831	0.4519	0.5891	0.6167	0.7511	0.8842
2	0.4521	0.5892	0.6119	0.7510	0.8781	0.4517	0.5892	0.6120	0.7499	0.8867
3	0.4475	0.5890	0.6142	0.7491	0.8842	0.4491	0.5910	0.6117	0.7523	0.8831
4	0.4491	0.5881	0.6097	0.7492	0.8867	0.4521	0.5908	0.6167	0.7514	0.8781
5	0.4521	0.5911	0.6088	0.7490	0.8817	0.4517	0.5886	0.6120	0.7509	0.8842

GRID	23					24				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.4620	0.5908	0.6119	0.7512	0.8841	0.4491	0.5910	0.6125	0.7515	0.8781
2	0.4520	0.5886	0.6142	0.7510	0.8840	0.4521	0.5891	0.6117	0.7482	0.8842
3	0.4491	0.5895	0.6097	0.7491	0.8817	0.4491	0.5910	0.6120	0.7491	0.8867
4	0.4521	0.5892	0.6088	0.7492	0.8817	0.4521	0.5908	0.6117	0.7511	0.8831
5	0.4475	0.5890	0.6167	0.7490	0.8831	0.4475	0.5892	0.6119	0.7483	0.8781

GRID	25				
DEPTH	0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5
1	0.4487	0.5890	0.6142	0.7512	0.8842
2	0.4525	0.5910	0.6097	0.7510	0.8841
3	0.4563	0.5891	0.6120	0.7491	0.8840
4	0.4601	0.5898	0.6117	0.7483	0.8867
5	0.4639	0.5991	0.6125	0.7473	0.8817

GRID	1					2				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.2400	2.5220	2.1515	2.3241	2.2394	2.2389	2.5211	2.1511	2.3237	2.2411
2	2.2391	2.5219	2.1517	2.3240	2.2391	2.2392	2.5216	2.1521	2.3235	2.2381
3	2.2389	2.5214	2.1509	2.3237	2.2385	2.2389	2.5211	2.1522	2.3250	2.2389
4	2.2411	2.5217	2.1520	2.3235	2.2391	2.2400	2.5215	2.1518	2.3231	2.2378
5	2.2390	2.5215	2.1507	2.3229	2.2379	2.2391	2.5225	2.1520	2.3235	2.2395

GRID	3					4				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.2389	2.5216	2.1515	2.3241	2.2385	2.2389	2.5215	2.1520	2.3251	2.2392
2	2.2391	2.5210	2.1517	2.3240	2.2391	2.2392	2.5225	2.1507	2.3235	2.239
3	2.2389	2.5230	2.1519	2.3221	2.2379	2.2388	2.5216	2.1511	2.3234	2.2391
4	2.2411	2.5235	2.1515	2.3235	2.2411	2.2392	2.5210	2.1518	2.3231	2.2379
5	2.2390	2.5216	2.1509	2.3198	2.2381	2.2389	2.5216	2.1507	2.3235	2.2411

GRID	5					6				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.2400	2.5220	2.1511	2.3241	2.2391	2.2389	2.5210	2.1520	2.3235	2.2378
2	2.2411	2.5223	2.1517	2.3240	2.2379	2.2392	2.5216	2.1515	2.3250	2.2395
3	2.2390	2.5214	2.1521	2.3235	2.2411	2.2388	2.5220	2.1522	2.3234	2.2385
4	2.2389	2.5217	2.1513	2.3229	2.2381	2.2392	2.5223	2.1518	2.3231	2.2391
5	2.2392	2.5240	2.1518	2.3237	2.2389	2.2389	2.5216	2.1507	2.3235	2.2381
GRID	7					8				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.2411	2.5220	2.1511	2.3241	2.2396	2.2389	2.5210	2.1518	2.3221	2.2387
2	2.2390	2.5219	2.1517	2.3240	2.2391	2.2392	2.5216	2.1509	2.3235	2.2381
3	2.2389	2.5214	2.1518	2.3237	2.2394	2.2388	2.5220	2.152	2.3198	2.2389
4	2.2392	2.5217	2.1521	2.3230	2.2391	2.2392	2.5210	2.1507	2.3251	2.2378
5	2.2390	2.5215	2.1513	2.3240	2.2385	2.2411	2.5216	2.1511	2.3235	2.2381

GRID	9					10				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.2390	2.5220	2.1515	2.3250	2.2389	2.2389	2.5211	2.1509	2.3238	2.2395
2	2.2389	2.5223	2.1522	2.3240	2.2378	2.2411	2.5210	2.1520	2.3229	2.2389
3	2.2392	2.5214	2.1509	2.3235	2.2395	2.2390	2.5216	2.1507	2.3234	2.2378
4	2.2411	2.5217	2.152	2.3228	2.2385	2.2389	2.5220	2.1511	2.3231	2.2395
5	2.2390	2.5215	2.1518	2.3230	2.2391	2.2392	2.5223	2.1520	2.3235	2.2385

GRID	11					12				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.2400	2.5241	2.1521	2.3241	2.2391	2.2389	2.5211	2.1517	2.3198	2.2381
2	2.2391	2.5219	2.1513	2.3228	2.2394	2.2411	2.5216	2.1521	2.3251	2.2389
3	2.2389	2.5245	2.1518	2.3240	2.2383	2.2390	2.5210	2.1509	2.3198	2.2378
4	2.2411	2.5217	2.1520	2.3221	2.2391	2.2389	2.5216	2.1520	2.3251	2.2381
5	2.2390	2.5225	2.1515	2.3235	2.2387	2.2392	2.5220	2.1507	2.3235	2.2387

GRID	13					14				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.2400	2.5223	2.1511	2.3240	2.2390	2.2389	2.5210	2.1517	2.3198	2.2381
2	2.2391	2.5241	2.1522	2.3221	2.2394	2.2411	2.5216	2.1521	2.3251	2.2394
3	2.2389	2.5214	2.1519	2.3240	2.2383	2.2390	2.5220	2.1522	2.3230	2.2389
4	2.2411	2.5217	2.1520	2.3221	2.2391	2.2389	2.5223	2.1518	2.3238	2.2391
5	2.2390	2.5215	2.1510	2.3235	2.2387	2.2392	2.5241	2.1509	2.3229	2.2387

GRID	15					16				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.2400	2.5220	2.1518	2.3241	2.2390	2.2392	2.5223	2.1517	2.3240	2.2381
2	2.2391	2.5219	2.1520	2.3240	2.2394	2.2392	2.5241	2.1521	2.3221	2.2378
3	2.2411	2.5210	2.1515	2.3221	2.2383	2.2388	2.5211	2.1522	2.3235	2.2395
4	2.2390	2.5216	2.1517	2.3235	2.2391	2.2411	2.5210	2.1518	2.3198	2.2385
5	2.2389	2.5220	2.1519	2.3198	2.2387	2.2390	2.5216	2.152	2.3251	2.2391

GRID	17					18				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.2389	2.5220	2.1515	2.3241	2.2395	2.2388	2.5216	2.1522	2.3240	2.2381
2	2.2392	2.5223	2.1511	2.3240	2.2391	2.2392	2.5220	2.1510	2.3221	2.2378
3	2.2389	2.5241	2.1519	2.3237	2.2383	2.2401	2.5223	2.1517	2.3235	2.2395
4	2.2411	2.5217	2.1507	2.3235	2.2391	2.2390	2.5241	2.1518	2.3240	2.2391
5	2.2390	2.5210	2.1511	2.3238	2.2387	2.2389	2.5216	2.1517	2.3221	2.2387

GRID	19					20				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.2392	2.5220	2.1519	2.3235	2.2390	2.2389	2.5216	2.1517	2.3221	2.2391
2	2.2391	2.5219	2.1507	2.3198	2.2391	2.2392	2.5220	2.1521	2.3235	2.2387
3	2.2389	2.5214	2.1511	2.3251	2.2381	2.2388	2.5223	2.1507	2.3198	2.2390
4	2.2411	2.5217	2.1522	2.3235	2.2378	2.2392	2.5241	2.1511	2.3251	2.2391
5	2.2390	2.5210	2.1510	2.3240	2.2395	2.2389	2.5216	2.1522	2.3240	2.2387

GRID	21					22				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.2400	2.5220	2.1510	2.3221	2.2378	2.2389	2.5211	2.1517	2.3198	2.2392
2	2.2391	2.5226	2.1517	2.3198	2.2395	2.2392	2.5216	2.1521	2.3198	2.2390
3	2.2389	2.5214	2.1519	2.3235	2.2385	2.2388	2.5220	2.1507	2.3251	2.2389
4	2.2411	2.5217	2.1522	2.3221	2.2391	2.2392	2.5223	2.1518	2.3231	2.2391
5	2.2390	2.5218	2.1510	2.3235	2.2381	2.2389	2.5241	2.1520	2.3235	2.2387

GRID	23					24				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.2400	2.5220	2.1515	2.3224	2.2390	2.2389	2.5211	2.1517	2.3226	2.2389
2	2.2391	2.5219	2.1510	2.3251	2.2391	2.2392	2.5216	2.1525	2.3247	2.2391
3	2.2389	2.5214	2.1517	2.3237	2.2381	2.2388	2.5211	2.1513	2.3234	2.2387
4	2.2411	2.5221	2.1520	2.3235	2.2392	2.2392	2.5214	2.1518	2.3235	2.2391
5	2.2390	2.5215	2.1507	2.3238	2.2390	2.2390	2.5216	2.1520	2.3235	2.2387

GRID	25				
DEPTH	0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5
1	2.2400	2.5220	2.1515	2.3241	2.2390
2	2.2391	2.5219	2.1522	2.3240	2.2391
3	2.2389	2.5214	2.1519	2.3237	2.2391
4	2.2411	2.5217	2.1520	2.3250	2.2391
5	2.2390	2.5215	2.1507	2.3238	2.2384

GRID	1					2				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.9112	3.2421	3.4125	3.4521	3.6712	2.9131	3.2421	3.4121	3.4520	3.6710
2	2.9119	3.2420	3.4121	3.4520	3.6710	2.9118	3.2412	3.4122	3.4521	3.6711
3	2.9109	3.2419	3.4130	3.4521	3.6709	2.9125	3.2424	3.4135	3.4520	3.6708
4	2.9114	3.2424	3.4119	3.4519	3.6714	2.9130	3.2419	3.4119	3.4525	3.6707
5	2.9109	3.2417	3.4120	3.4517	3.6712	2.9132	3.2410	3.4125	3.4517	3.6801

GRID	3					4				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.9112	3.242	3.4121	3.4521	3.6712	2.9131	3.2419	3.4121	3.4521	3.6710
2	2.9109	3.2419	3.4122	3.4520	3.6710	2.9118	3.242	3.4129	3.4520	3.6711
3	2.9131	3.2424	3.4132	3.4521	3.6709	2.9125	3.2419	3.4119	3.4521	3.6708
4	2.9118	3.2421	3.1419	3.4520	3.6714	2.9130	3.2421	3.4125	3.4520	3.6707
5	2.9109	3.242	3.4121	3.4521	3.6712	2.9132	3.2421	3.4121	3.4521	3.6806

GRID	5					6				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.9112	3.2412	3.4126	3.4520	3.6711	2.9125	3.2424	3.4121	3.4519	3.6710
2	2.9110	3.2424	3.4119	3.4525	3.6710	2.9120	3.2421	3.4119	3.4521	3.6711
3	2.9109	3.2419	3.4120	3.4517	3.6709	2.9115	3.2420	3.4137	3.4521	3.6708
4	2.9131	3.2421	3.4121	3.4520	3.6714	2.9113	3.2419	3.4121	3.4520	3.6712
5	2.9118	3.2422	3.4133	3.4528	3.6712	2.9130	3.2421	3.4129	3.4521	3.6710

GRID	7					8				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.9127	3.2418	3.4119	3.4520	3.6709	2.9109	3.2419	3.4119	3.4519	3.6708
2	2.9118	3.2417	3.4120	3.4525	3.6714	2.9111	3.2421	3.4125	3.4521	3.6707
3	2.9125	3.2421	3.4121	3.4517	3.6712	2.9115	3.2420	3.4121	3.4520	3.6806
4	2.9112	3.2422	3.4118	3.4520	3.6710	2.9122	3.2415	3.4119	3.4521	3.6707
5	2.9114	3.2424	3.4134	3.4528	3.6711	2.9128	3.2417	3.4137	3.4519	3.6712

GRID	9					10				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.9114	3.2421	3.4121	3.4519	3.6712	2.9109	3.2435	3.4119	3.4518	3.6710
2	2.9109	3.2424	3.4119	3.4520	3.6710	2.9111	3.2421	3.4125	3.4525	3.6711
3	2.9131	3.2419	3.4125	3.4521	3.6709	2.9129	3.2422	3.4121	3.4517	3.6708
4	2.9118	3.2421	3.4121	3.4520	3.6714	2.9113	3.2417	3.4130	3.4520	3.6707
5	2.9125	3.2418	3.4126	3.4521	3.6712	2.9114	3.2421	3.4119	3.4528	3.6712

GRID	11					12				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.9109	3.2422	3.4120	3.4519	3.6712	2.9109	3.2420	3.4119	3.4520	3.6710
2	2.9131	3.2424	3.4121	3.4521	3.6710	2.9111	3.2419	3.4133	3.4521	3.6711
3	2.9118	3.2418	3.4125	3.4520	3.6709	2.9113	3.2418	3.4119	3.4519	3.6708
4	2.9125	3.2435	3.4121	3.4521	3.6714	2.9130	3.2417	3.4125	3.4523	3.6707
5	2.9114	3.2421	3.4126	3.4515	3.6712	2.9127	3.2421	3.4121	3.4520	3.6710

GRID	13					14				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.9118	3.2424	3.4130	3.4534	3.6709	2.9127	3.2419	3.4119	3.4520	3.6708
2	2.9109	3.2418	3.4119	3.4521	3.6714	2.9118	3.2418	3.4120	3.4519	3.6707
3	2.9131	3.2435	3.4125	3.4518	3.6712	2.9113	3.2417	3.4121	3.4519	3.6708
4	2.9113	3.2421	3.4121	3.4525	3.6710	2.9130	3.2424	3.4133	3.4520	3.6707
5	2.9130	3.2420	3.4130	3.4517	3.6711	2.9127	3.2418	3.4122	3.4525	3.6712

GRID	15					16				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.9118	3.2435	3.4125	3.4520	3.6710	2.9109	3.2418	3.4119	3.4521	3.6711
2	2.9109	3.2421	3.4121	3.4521	3.6709	2.9131	3.2417	3.4125	3.4519	3.6708
3	2.9131	3.2421	3.4126	3.4521	3.6714	2.9118	3.2421	3.4121	3.4523	3.6712
4	2.9118	3.2420	3.4119	3.4515	3.6712	2.9120	3.2422	3.4122	3.4520	3.6710
5	2.9125	3.2419	3.4133	3.4520	3.6710	2.9113	3.2424	3.4121	3.4534	3.6709

GRID	17					18				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.9130	3.2419	3.4119	3.4521	3.6714	2.9131	3.2417	3.4126	3.4519	3.6712
2	2.9127	3.2421	3.4125	3.4518	3.6712	2.9111	3.2421	3.4119	3.4519	3.6710
3	2.9118	3.2420	3.4133	3.4525	3.6710	2.9125	3.2422	3.4133	3.4520	3.6709
4	2.9112	3.2419	3.4125	3.4517	3.6711	2.9113	3.2424	3.4119	3.4525	3.6714
5	2.9128	3.2418	3.4121	3.4520	3.6708	2.9130	3.2419	3.4125	3.4521	3.6712

GRID	19					20				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.9127	3.2421	3.4121	3.4521	3.6710	2.9118	3.2421	3.4125	3.4515	3.6710
2	2.9118	3.2420	3.4126	3.4520	3.6711	2.9125	3.2422	3.4121	3.4520	3.6711
3	2.9109	3.2419	3.4119	3.4521	3.6708	2.9130	3.2424	3.4121	3.4521	3.6708
4	2.9112	3.2418	3.4133	3.4519	3.6707	2.9132	3.2419	3.4119	3.4519	3.6707
5	2.9131	3.2417	3.4119	3.4521	3.6712	2.9114	3.2421	3.4125	3.4521	3.6712

GRID	21					22				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.9112	3.2420	3.4121	3.4515	3.6710	2.9127	3.2421	3.4125	3.4520	3.6711
2	2.9110	3.2419	3.4126	3.4520	3.6709	2.9118	3.2420	3.4121	3.4534	3.6708
3	2.9109	3.2418	3.4119	3.4521	3.6714	2.9132	3.2419	3.4119	3.4521	3.6707
4	2.9113	3.2422	3.4133	3.4519	3.6712	2.9113	3.2421	3.4125	3.4518	3.6712
5	2.9130	3.2424	3.4119	3.4523	3.6710	2.9114	3.2418	3.4121	3.4525	3.6712

GRID	23					24				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.9112	3.2417	3.4119	3.4517	3.6811	2.9113	3.2419	3.4133	3.4521	3.6710
2	2.9110	3.2418	3.4125	3.4520	3.6710	2.9130	3.2425	3.4125	3.4519	3.6709
3	2.9109	3.2417	3.4121	3.4521	3.6709	2.9127	3.2419	3.4121	3.4523	3.6714
4	2.9112	3.2421	3.4126	3.4515	3.6714	2.9118	3.2420	3.4126	3.4520	3.6712
5	2.9131	3.2422	3.4119	3.4520	3.6712	2.9114	3.2417	3.4119	3.4534	3.6710

GRID	25				
DEPTH	15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5
1	2.9112	3.2425	3.4133	3.4521	3.6711
2	2.9113	3.2419	3.4119	3.4518	3.6708
3	2.9130	3.2421	3.4125	3.4525	3.6707
4	2.9127	3.2422	3.4121	3.4517	3.6712
5	2.9118	3.2419	3.4133	3.4520	3.6712

GRID	1					2				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.8921	2.9211	2.1611	2.4215	2.5611	2.8915	2.9220	2.1609	2.4225	2.5624
2	2.8921	2.9209	2.1620	2.4209	2.5609	2.8924	2.9225	2.1589	2.4195	2.5631
3	2.8935	2.9189	2.1589	2.4211	2.5597	2.8916	2.9197	2.1621	2.4210	2.5635
4	2.8919	2.9197	2.1625	2.4209	2.5616	2.8924	2.9221	2.1624	2.4215	2.5614
5	2.8891	2.9215	2.1630	2.4211	2.5621	2.8921	2.9217	2.1630	2.4189	2.5589

GRID	3					4				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.8891	2.9187	2.1589	2.4221	2.5625	2.8931	2.9197	2.1630	2.4225	2.5611
2	2.8919	2.9195	2.1611	2.4212	2.5618	2.8922	2.9215	2.1609	2.4215	2.5609
3	2.8891	2.9211	2.1620	2.4215	2.5611	2.8924	2.9220	2.1589	2.4209	2.5597
4	2.8897	2.9209	2.1589	2.4209	2.5609	2.8931	2.9197	2.1621	2.4211	2.5616
5	2.8919	2.9189	2.1625	2.4211	2.5597	2.8895	2.9215	2.1624	2.4225	2.5631

GRID	5					6				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.8935	2.9220	2.1621	2.4217	2.5635	2.8924	2.9209	2.1589	2.4215	2.5625
2	2.8919	2.9197	2.1624	2.4209	2.5614	2.8916	2.9189	2.1625	2.4215	2.5618
3	2.8919	2.9225	2.1630	2.4211	2.5589	2.8897	2.9197	2.1630	2.4209	2.5611
4	2.8891	2.9221	2.1611	2.4225	2.5614	2.8919	2.9211	2.1609	2.4211	2.5609
5	2.8915	2.9211	2.1620	2.4195	2.5589	2.8931	2.9209	2.1589	2.4225	2.5597

GRID	7					8				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.8922	2.9189	2.1621	2.4209	2.5611	2.8916	2.9225	2.1589	2.4225	2.5624
2	2.8924	2.9197	2.1624	2.4211	2.5609	2.8924	2.9221	2.1611	2.4209	2.5631
3	2.8931	2.9215	2.1625	2.4225	2.5635	2.8919	2.9211	2.1620	2.4211	2.5635
4	2.8895	2.9220	2.1630	2.4209	2.5614	2.8891	2.9209	2.1589	2.4209	2.5614
5	2.8924	2.9225	2.1609	2.4211	2.5621	2.8915	2.9189	2.1625	2.4211	2.5589

GRID	9					10				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.8924	2.9211	2.1630	2.4225	2.5616	2.8919	2.9209	2.1589	2.4211	2.5625
2	2.8916	2.9209	2.1609	2.4209	2.5631	2.8931	2.9189	2.1625	2.4225	2.5618
3	2.8924	2.9189	2.1589	2.4217	2.5635	2.8922	2.9197	2.1630	2.4225	2.5611
4	2.8919	2.9197	2.1611	2.4215	2.5614	2.8924	2.9215	2.1589	2.4215	2.5609
5	2.8897	2.9211	2.1620	2.4209	2.5589	2.8931	2.9211	2.1621	2.4209	2.5597

GRID	11					12				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.8895	2.9209	2.1624	2.4210	2.5611	2.8917	2.9211	2.1589	2.4215	2.5614
2	2.8919	2.9189	2.1630	2.4215	2.5609	2.8917	2.9209	2.1625	2.4209	2.5589
3	2.8891	2.9197	2.1589	2.4225	2.5624	2.8916	2.9189	2.1630	2.4211	2.5614
4	2.8919	2.9220	2.1611	2.4215	2.5631	2.8897	2.9197	2.1624	2.4225	2.5589
5	2.8920	2.9225	2.1620	2.4209	2.5635	2.8919	2.9189	2.1630	2.4217	2.5625

GRID	13					14				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.8931	2.9211	2.1589	2.4225	2.5618	2.8922	2.9189	2.1630	2.4215	2.5611
2	2.8922	2.9209	2.1611	2.4215	2.5611	2.8924	2.9197	2.1589	2.4209	2.5609
3	2.8897	2.9189	2.1589	2.4209	2.5609	2.8931	2.9215	2.1589	2.4215	2.5624
4	2.8919	2.9211	2.1621	2.4217	2.5597	2.8895	2.9220	2.1621	2.4215	2.5631
5	2.8931	2.9209	2.1624	2.4225	2.5611	2.8922	2.9197	2.1624	2.4209	2.5635

GRID	15					16				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.8924	2.9215	2.1630	2.4211	2.5614	2.8924	2.9197	2.1625	2.4217	2.5589
2	2.8931	2.9220	2.1589	2.4215	2.5589	2.8931	2.9215	2.1630	2.4215	2.5625
3	2.8891	2.9225	2.1611	2.4209	2.5614	2.8922	2.9220	2.1589	2.4209	2.5618
4	2.8919	2.9189	2.1620	2.4211	2.5589	2.8924	2.9189	2.1621	2.4211	2.5611
5	2.8922	2.9221	2.1589	2.4225	2.5614	2.8931	2.9220	2.1624	2.4225	2.5609

GRID	17					18				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.8921	2.9211	2.1630	2.4217	2.5597	2.8917	2.9220	2.1625	2.4225	2.5589
2	2.8919	2.9209	2.1589	2.4225	2.5611	2.8919	2.9189	2.1630	2.4215	2.5614
3	2.8922	2.9189	2.1611	2.4215	2.5609	2.8922	2.9197	2.1589	2.4209	2.5589
4	2.8924	2.9197	2.1620	2.4209	2.5635	2.8920	2.9215	2.1621	2.4211	2.5625
5	2.8931	2.9215	2.1589	2.4211	2.5614	2.8919	2.9220	2.1624	2.4225	2.5618

GRID	19					20				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.8922	2.9225	2.1630	2.4217	2.5611	2.8922	2.9189	2.1589	2.4225	2.5589
2	2.8919	2.9209	2.1589	2.4217	2.5609	2.8917	2.9197	2.1611	2.4217	2.5625
3	2.8891	2.9221	2.1611	2.4195	2.5597	2.8916	2.9215	2.1620	2.4225	2.5618
4	2.8919	2.9211	2.1624	2.4209	2.5611	2.8924	2.9220	2.1589	2.4215	2.5611
5	2.8919	2.9209	2.1630	2.4211	2.5614	2.8931	2.9209	2.1621	2.4209	2.5631

GRID	21					22				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.8921	2.9225	2.1624	2.4217	2.5635	2.8921	2.9220	2.1589	2.4217	2.5625
2	2.8919	2.9209	2.1630	2.4225	2.5614	2.8917	2.9189	2.1625	2.4195	2.5618
3	2.8891	2.9189	2.1589	2.4215	2.5589	2.8924	2.9225	2.1630	2.4209	2.5611
4	2.8924	2.9197	2.1611	2.4209	2.5614	2.8931	2.9221	2.1589	2.4211	2.5614
5	2.8931	2.9215	2.1620	2.4210	2.5589	2.8924	2.9211	2.1611	2.4225	2.5589

GRID	23					24				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.8931	2.9209	2.1620	2.4217	2.5625	2.8921	2.9209	2.1589	2.4225	2.5635
2	2.8921	2.9189	2.1589	2.4225	2.5618	2.8917	2.9189	2.1621	2.4215	2.5614
3	2.8891	2.9197	2.1621	2.4215	2.5611	2.8915	2.9211	2.1624	2.4209	2.5614
4	2.8924	2.9215	2.1624	2.4209	2.5624	2.8924	2.9197	2.1630	2.4215	2.5589
5	2.8931	2.9220	2.1630	2.4217	2.5631	2.8916	2.9215	2.1589	2.4225	2.5625

GRID	25				
DEPTH	15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5
1	2.8924	2.9220	2.1611	2.4217	2.5618
2	2.8921	2.9211	2.1620	2.4217	2.5611
3	2.8891	2.9209	2.1589	2.4195	2.5624
4	2.8919	2.9189	2.1625	2.4210	2.5631
5	2.8920	2.9197	2.1630	2.4215	2.5635

COHESION MEASUREMENTS
RAW DATA ON COHESION FOR INDIVIDUAL GRIDS FOR KADE SOIL

GRID	1					2				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.120	0.211	0.157	0.401	0.411	0.132	0.214	0.147	0.415	0.414
2	0.119	0.221	0.149	0.392	0.409	0.125	0.241	0.151	0.372	0.402
3	0.122	0.231	0.162	0.388	0.422	0.124	0.211	0.147	0.361	0.395
4	0.130	0.227	0.151	0.415	0.412	0.120	0.209	0.158	0.422	0.405
5	0.125	0.215	0.145	0.397	0.389	0.125	0.215	0.152	0.374	0.416

GRID	3					4				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.119	0.302	0.162	0.411	0.391	0.118	0.215	0.150	0.374	0.419
2	0.128	0.219	0.156	0.401	0.389	0.126	0.224	0.149	0.376	0.422
3	0.121	0.231	0.144	0.372	0.412	0.135	0.219	0.152	0.410	0.412
4	0.119	0.218	0.160	0.361	0.4	0.125	0.221	0.145	0.397	0.392
5	0.124	0.228	0.161	0.422	0.411	0.122	0.221	0.152	0.372	0.419

GRID	5					6				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.118	0.241	0.160	0.361	0.402	0.115	0.219	0.147	0.372	0.389
2	0.126	0.211	0.161	0.422	0.389	0.131	0.231	0.150	0.361	0.393
3	0.122	0.208	0.150	0.415	0.412	0.121	0.218	0.162	0.411	0.409
4	0.119	0.215	0.151	0.397	0.402	0.118	0.228	0.150	0.382	0.414

5	0.126	0.241	0.150	0.415	0.415	0.122	0.233	0.147	0.387	0.415
GRID	7					8				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.120	0.231	0.151	0.372	0.389	0.135	0.229	0.149	0.372	0.389
2	0.116	0.215	0.149	0.361	0.414	0.125	0.231	0.152	0.361	0.403
3	0.134	0.221	0.160	0.378	0.402	0.124	0.219	0.145	0.415	0.412
4	0.118	0.216	0.161	0.415	0.385	0.120	0.231	0.157	0.397	0.402
5	0.126	0.231	0.150	0.388	0.412	0.125	0.221	0.156	0.415	0.415

GRID	9					10				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.119	0.231	0.160	0.372	0.387	0.126	0.219	0.145	0.361	0.411
2	0.128	0.214	0.161	0.415	0.402	0.122	0.231	0.156	0.382	0.402
3	0.125	0.207	0.150	0.397	0.389	0.124	0.218	0.152	0.397	0.389
4	0.124	0.225	0.149	0.415	0.412	0.125	0.228	0.160	0.421	0.42
5	0.122	0.245	0.152	0.372	0.415	0.124	0.215	0.161	0.391	0.389

GRID	11					12				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.122	0.224	0.150	0.392	0.403	0.124	0.211	0.152	0.415	0.412
2	0.126	0.219	0.160	0.394	0.412	0.122	0.215	0.160	0.372	0.38
3	0.122	0.221	0.161	0.387	0.415	0.121	0.215	0.161	0.415	0.422
4	0.126	0.211	0.150	0.372	0.415	0.121	0.285	0.150	0.397	0.41
5	0.125	0.241	0.149	0.397	0.389	0.145	0.221	0.149	0.415	0.414

GRID	13					14				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.125	0.225	0.160	0.395	0.411	0.145	0.228	0.145	0.415	0.414
2	0.122	0.275	0.161	0.39	0.405	0.125	0.215	0.157	0.372	0.411
3	0.124	0.219	0.150	0.388	0.415	0.122	0.224	0.156	0.415	0.402
4	0.121	0.231	0.149	0.392	0.386	0.122	0.219	0.152	0.397	0.389
5	0.121	0.218	0.152	0.397	0.41	0.126	0.221	0.147	0.415	0.42

GRID	15					16				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.117	0.225	0.151	0.391	0.389	0.145	0.302	0.156	0.397	0.412
2	0.124	0.241	0.147	0.397	0.403	0.125	0.219	0.144	0.415	0.41
3	0.122	0.221	0.158	0.415	0.412	0.122	0.231	0.160	0.394	0.411
4	0.119	0.218	0.152	0.372	0.415	0.124	0.218	0.161	0.391	0.402
5	0.121	0.225	0.162	0.415	0.415	0.121	0.228	0.150	0.391	0.389

GRID	17					18				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.121	0.215	0.151	0.422	0.42	0.119	0.241	0.156	0.394	0.405
2	0.145	0.224	0.152	0.395	0.389	0.122	0.221	0.147	0.391	0.415
3	0.125	0.219	0.153	0.388	0.403	0.130	0.225	0.151	0.401	0.412
4	0.122	0.221	0.151	0.376	0.412	0.125	0.302	0.147	0.389	0.401
5	0.126	0.218	0.157	0.411	0.415	0.119	0.219	0.158	0.395	0.411

GRID	19					20				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.122	0.231	0.152	0.415	0.405	0.124	0.219	0.161	0.411	0.411
2	0.130	0.218	0.162	0.388	0.415	0.119	0.23	0.153	0.394	0.409
3	0.125	0.228	0.156	0.395	0.386	0.122	0.221	0.151	0.415	0.415
4	0.132	0.215	0.144	0.388	0.41	0.130	0.241	0.157	0.397	0.412
5	0.125	0.224	0.160	0.376	0.414	0.125	0.233	0.156	0.415	0.41

GRID	21					22				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.132	0.233	0.152	0.394	0.414	0.125	0.218	0.158	0.415	0.415
2	0.125	0.225	0.160	0.391	0.413	0.132	0.228	0.152	0.388	0.412
3	0.119	0.302	0.147	0.392	0.413	0.125	0.215	0.162	0.422	0.41
4	0.122	0.219	0.151	0.394	0.411	0.119	0.224	0.156	0.394	0.414
5	0.130	0.231	0.147	0.395	0.409	0.122	0.219	0.144	0.395	0.409

GRID	23					24				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.130	0.221	0.160	0.395	0.415	0.132	0.302	0.151	0.396	0.409
2	0.125	0.218	0.161	0.401	0.412	0.125	0.219	0.147	0.389	0.415
3	0.132	0.241	0.160	0.392	0.41	0.124	0.231	0.151	0.395	0.412
4	0.125	0.221	0.161	0.394	0.414	0.120	0.224	0.147	0.412	0.41
5	0.124	0.225	0.150	0.391	0.411	0.130	0.219	0.158	0.405	0.411

GRID	25				
DEPTH	0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5
1	0.125	0.221	0.152	0.392	0.409
2	0.132	0.218	0.162	0.394	0.415
3	0.125	0.241	0.156	0.391	0.412
4	0.124	0.221	0.144	0.39	0.41
5	0.120	0.311	0.160	0.389	0.414

GRID	1					2				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.492	1.125	0.61	0.612	0.481	0.457	1.132	0.599	0.613	0.49
2	0.511	1.130	0.58	0.607	0.492	0.508	1.141	0.619	0.589	0.488
3	0.480	1.142	0.615	0.622	0.42	0.477	1.134	0.624	0.614	0.429
4	0.487	1.151	0.579	0.592	0.491	0.450	1.142	0.575	0.607	0.491
5	0.490	1.128	0.622	0.623	0.472	0.518	1.145	0.627	0.623	0.492

GRID	3					4				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.516	1.125	0.622	0.612	0.481	0.502	1.140	0.622	0.613	0.475
2	0.480	1.142	0.599	0.608	0.492	0.487	1.141	0.599	0.614	0.488
3	0.511	1.130	0.625	0.625	0.468	0.490	1.134	0.625	0.607	0.49
4	0.508	1.142	0.624	0.611	0.491	0.457	1.131	0.624	0.623	0.491
5	0.468	1.151	0.611	0.622	0.489	0.508	1.128	0.598	0.611	0.475

GRID	5					6				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.477	1.139	0.617	0.605	0.481	0.489	1.140	0.624	0.589	0.429
2	0.450	1.130	0.627	0.622	0.492	0.508	1.141	0.575	0.614	0.491
3	0.518	1.142	0.622	0.592	0.481	0.511	1.134	0.627	0.607	0.492
4	0.516	1.151	0.599	0.623	0.491	0.510	1.130	0.622	0.623	0.481
5	0.490	1.139	0.619	0.613	0.488	0.498	1.142	0.624	0.611	0.492

GRID	7					8				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.492	1.151	0.599	0.612	0.468	0.477	1.128	0.575	0.589	0.49
2	0.511	1.139	0.625	0.622	0.491	0.450	1.132	0.627	0.622	0.488
3	0.492	1.250	0.624	0.592	0.489	0.518	1.141	0.619	0.592	0.488
4	0.457	1.141	0.619	0.623	0.491	0.516	1.120	0.624	0.623	0.429
5	0.508	1.151	0.624	0.613	0.489	0.492	1.140	0.575	0.613	0.491

GRID	9					10				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.509	1.132	0.627	0.589	0.492	0.457	1.141	0.619	0.613	0.488
2	0.490	1.151	0.622	0.614	0.481	0.508	1.120	0.624	0.589	0.429
3	0.489	1.141	0.621	0.622	0.492	0.477	1.130	0.575	0.614	0.491
4	0.508	1.142	0.625	0.592	0.468	0.450	1.142	0.627	0.607	0.492
5	0.511	1.151	0.617	0.623	0.491	0.518	1.151	0.622	0.623	0.42

GRID	11					12				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.516	1.142	0.621	0.625	0.491	0.511	1.142	0.617	0.607	0.489
2	0.511	1.151	0.625	0.611	0.489	0.492	1.131	0.619	0.623	0.49
3	0.492	1.141	0.617	0.622	0.492	0.509	1.128	0.624	0.611	0.488
4	0.509	1.120	0.625	0.613	0.42	0.490	1.142	0.575	0.605	0.429
5	0.492	1.134	0.627	0.614	0.491	0.489	1.151	0.627	0.625	0.491

GRID	13					14				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.457	1.141	0.622	0.611	0.492	0.516	1.142	0.627	0.623	0.491
2	0.508	1.120	0.61	0.622	0.481	0.489	1.131	0.617	0.625	0.489
3	0.477	1.142	0.621	0.613	0.492	0.508	1.128	0.61	0.611	0.49
4	0.450	1.141	0.625	0.614	0.492	0.518	1.142	0.621	0.622	0.488
5	0.518	1.125	0.575	0.607	0.42	0.520	1.151	0.612	0.613	0.429

GRID	15					16				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.498	1.141	0.617	0.614	0.491	0.518	1.142	0.625	0.622	0.489
2	0.457	1.151	0.616	0.607	0.492	0.507	1.151	0.592	0.592	0.49
3	0.508	1.128	0.62	0.623	0.492	0.492	1.141	0.627	0.625	0.488
4	0.477	1.132	0.575	0.611	0.42	0.450	1.125	0.625	0.611	0.429
5	0.450	1.145	0.627	0.605	0.491	0.489	1.151	0.627	0.622	0.491

GRID	17					18				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.457	1.128	0.61	0.613	0.492	0.516	1.141	0.62	0.605	0.429
2	0.508	1.132	0.621	0.614	0.481	0.508	1.128	0.625	0.622	0.491
3	0.477	1.151	0.615	0.607	0.492	0.492	1.132	0.627	0.592	0.492
4	0.450	1.128	0.588	0.623	0.49	0.457	1.145	0.596	0.623	0.481
5	0.518	1.132	0.616	0.611	0.488	0.508	1.142	0.627	0.608	0.492

GRID	19					20				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.450	1.142	0.582	0.589	0.492	0.511	1.125	0.625	0.623	0.488
2	0.489	1.125	0.616	0.611	0.42	0.492	1.142	0.627	0.612	0.429
3	0.457	1.142	0.62	0.607	0.491	0.509	1.128	0.615	0.621	0.491
4	0.508	1.131	0.625	0.611	0.489	0.492	1.128	0.617	0.61	0.456
5	0.477	1.128	0.627	0.612	0.49	0.511	1.132	0.616	0.592	0.492

GRID	21					22				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.492	1.145	0.62	0.623	0.481	0.457	1.128	0.625	0.611	0.49
2	0.509	1.142	0.625	0.608	0.492	0.508	1.139	0.617	0.612	0.488
3	0.490	1.125	0.627	0.589	0.49	0.508	1.128	0.611	0.623	0.49
4	0.489	1.142	0.61	0.611	0.491	0.516	1.132	0.58	0.612	0.491
5	0.492	1.131	0.621	0.607	0.489	0.508	1.145	0.58	0.621	0.492

GRID	23					24				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.492	1.142	0.615	0.612	0.481	0.508	1.140	0.615	0.589	0.49
2	0.457	1.142	0.579	0.611	0.492	0.492	1.141	0.579	0.611	0.468
3	0.508	1.131	0.622	0.592	0.49	0.457	1.128	0.622	0.607	0.491
4	0.457	1.128	0.599	0.623	0.491	0.508	1.132	0.599	0.611	0.489
5	0.516	1.139	0.58	0.608	0.489	0.492	1.145	0.615	0.612	0.475

GRID	25				
DEPTH	0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5
1	0.457	1.128	0.579	0.623	0.488
2	0.508	1.132	0.622	0.592	0.49
3	0.490	1.145	0.599	0.623	0.491
4	0.489	1.142	0.625	0.608	0.475
5	0.508	1.139	0.627	0.589	0.488

GRID	1					2				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.295	0.591	0.854	1.252	1.385	0.291	0.58	0.862	1.229	1.379
2	0.256	0.589	0.872	1.241	1.35	0.285	0.611	0.868	1.235	1.352
3	0.27	0.575	0.864	1.231	1.411	0.29	0.584	0.861	1.249	1.389
4	0.285	0.561	0.855	1.221	1.362	0.287	0.582	0.852	1.257	1.401
5	0.85	0.578	0.861	1.216	1.39	0.288	0.581	0.849	1.217	1.416

GRID	3					4				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.295	0.591	0.854	1.235	1.385	0.291	0.562	0.861	1.235	1.352
2	0.256	0.577	0.855	1.262	1.379	0.285	0.582	0.852	1.249	1.411
3	0.272	0.575	0.861	1.229	1.387	0.289	0.584	0.862	1.257	1.362
4	0.285	0.561	0.862	1.252	1.39	0.287	0.549	0.868	1.246	1.39
5	0.29	0.578	0.868	1.231	1.379	0.288	0.581	0.861	1.227	1.379

GRID	5					6				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.295	0.58	0.852	1.257	1.389	0.291	0.591	0.862	1.235	1.379
2	0.256	0.611	0.86	1.23	1.401	0.285	0.577	0.86	1.229	1.389
3	0.271	0.584	0.864	1.225	1.411	0.292	0.58	0.861	1.23	1.401
4	0.285	0.582	0.855	1.262	1.362	0.287	0.611	0.852	1.232	1.39
5	0.29	0.581	0.861	1.229	1.39	0.288	0.584	0.858	1.257	1.379

GRID	7					8				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.295	0.582	0.855	1.246	1.352	0.291	0.561	0.852	1.249	1.39
2	0.256	0.581	0.861	1.227	1.389	0.285	0.578	0.86	1.257	1.379
3	0.281	0.591	0.862	1.257	1.401	0.279	0.562	0.861	1.23	1.379
4	0.285	0.577	0.868	1.23	1.411	0.287	0.582	0.852	1.235	1.362
5	0.287	0.575	0.861	1.225	1.362	0.288	0.581	0.858	1.262	1.39

GRID	9					10				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.295	0.58	0.854	1.229	1.401	0.291	0.58	0.861	1.249	1.401
2	0.256	0.611	0.855	1.235	1.39	0.285	0.611	0.852	1.257	1.416
3	0.27	0.584	0.861	1.229	1.379	0.29	0.584	0.861	1.257	1.39
4	0.285	0.582	0.862	1.235	1.352	0.287	0.582	0.852	1.246	1.379
5	0.29	0.581	0.868	1.229	1.389	0.288	0.581	0.858	1.227	1.352

GRID	11					12				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.295	0.591	0.854	1.257	1.389	0.291	0.582	0.862	1.252	1.379
2	0.256	0.577	0.86	1.23	1.401	0.285	0.581	0.86	1.249	1.352
3	0.27	0.58	0.864	1.225	1.416	0.29	0.591	0.861	1.246	1.389
4	0.285	0.611	0.855	1.235	1.385	0.287	0.577	0.852	1.257	1.401
5	0.29	0.584	0.861	1.262	1.39	0.288	0.58	0.858	1.246	1.416

GRID	13					14				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.295	0.611	0.854	1.227	1.385	0.291	0.577	0.862	1.262	1.379
2	0.256	0.584	0.86	1.257	1.379	0.285	0.575	0.86	1.229	1.352
3	0.27	0.582	0.864	1.221	1.352	0.29	0.561	0.861	1.264	1.389
4	0.285	0.581	0.855	1.248	1.389	0.287	0.578	0.852	1.229	1.401
5	0.29	0.591	0.861	1.235	1.39	0.288	0.562	0.858	1.231	1.39

GRID	15					16				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.295	0.591	0.854	1.249	1.379	0.291	0.584	0.862	1.257	1.385
2	0.256	0.589	0.86	1.257	1.352	0.285	0.582	0.86	1.246	1.39
3	0.27	0.575	0.864	1.252	1.389	0.29	0.581	0.861	1.252	1.379
4	0.285	0.58	0.855	1.249	1.401	0.287	0.591	0.852	1.249	1.352
5	0.29	0.611	0.861	1.246	1.416	0.288	0.577	0.858	1.246	1.389

GRID	17					18				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.295	0.575	0.854	1.257	1.401	0.291	0.577	0.862	1.229	1.389
2	0.256	0.561	0.86	1.246	1.416	0.285	0.575	0.86	1.246	1.401
3	0.27	0.578	0.864	1.227	1.385	0.29	0.561	0.861	1.257	1.352
4	0.285	0.562	0.855	1.257	1.389	0.287	0.58	0.852	1.246	1.401
5	0.29	0.591	0.861	1.229	1.352	0.288	0.611	0.858	1.249	1.39

GRID	19					20				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.295	0.58	0.854	1.257	1.379	0.291	0.591	0.862	1.249	1.352
2	0.256	0.611	0.86	1.23	1.352	0.285	0.577	0.86	1.246	1.401
3	0.27	0.584	0.864	1.235	1.401	0.29	0.575	0.861	1.257	1.39
4	0.285	0.582	0.855	1.262	1.39	0.287	0.561	0.852	1.246	1.379
5	0.29	0.581	0.861	1.229	1.379	0.288	0.578	0.858	1.262	1.352

GRID	21					22				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.295	0.562	0.854	1.229	1.389	0.291	0.58	0.862	1.229	1.352
2	0.256	0.575	0.86	1.246	1.401	0.285	0.582	0.86	1.249	1.379
3	0.27	0.561	0.864	1.257	1.389	0.29	0.584	0.861	1.246	1.387
4	0.285	0.578	0.855	1.246	1.401	0.287	0.582	0.852	1.257	1.411
5	0.29	0.562	0.861	1.262	1.411	0.288	0.581	0.858	1.246	1.352

GRID	23					24				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.295	0.591	0.854	1.262	1.389	0.291	0.58	0.862	1.246	1.352
2	0.256	0.589	0.86	1.256	1.401	0.285	0.582	0.86	1.262	1.39
3	0.27	0.575	0.864	1.229	1.389	0.29	0.584	0.861	1.226	1.389
4	0.285	0.561	0.855	1.246	1.401	0.287	0.582	0.852	1.235	1.352
5	0.29	0.578	0.861	1.257	1.411	0.288	0.581	0.858	1.229	1.389

GRID	25				
DEPTH	15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5
1	0.295	0.591	0.854	1.235	1.401
2	0.256	0.589	0.86	1.262	1.389
3	0.27	0.575	0.872	1.238	1.401
4	0.285	0.561	0.866	1.249	1.352
5	0.29	0.578	0.859	1.257	1.389

GRID	1					2				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.411	0.687	0.784	0.845	1.112	0.291	0.691	0.806	0.925	1.12
2	0.269	0.690	0.811	0.857	0.942	0.269	0.595	0.761	0.812	0.959
3	0.320	0.575	0.757	0.860	1.114	0.324	0.685	0.791	0.942	0.942
4	0.317	0.565	0.779	0.944	0.962	0.401	0.691	0.815	0.944	1.112
5	0.411	0.561	0.791	0.835	1.115	0.411	0.564	0.784	0.895	0.945

GRID	3					4				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.291	0.595	0.742	0.845	1.115	0.411	0.690	0.791	0.944	1.114
2	0.269	0.685	0.791	0.857	0.942	0.411	0.575	0.742	0.812	0.945
3	0.324	0.691	0.779	0.860	1.114	0.269	0.565	0.757	0.935	1.121
4	0.401	0.564	0.801	0.944	0.962	0.325	0.561	0.779	0.940	1.01
5	0.291	0.687	0.784	0.835	1.115	0.317	0.691	0.801	0.895	0.942

GRID	5					6				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.411	0.595	0.761	0.845	1.114	0.411	0.690	0.791	0.951	0.962
2	0.291	0.685	0.791	0.857	0.962	0.269	0.575	0.779	0.812	1.115
3	0.269	0.691	0.784	0.860	1.115	0.32	0.565	0.801	0.942	1.12
4	0.324	0.564	0.749	0.944	1.112	0.317	0.561	0.791	0.926	0.959
5	0.401	0.687	0.742	0.835	0.942	0.411	0.691	0.815	0.895	0.942

GRID	7					8				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.291	0.595	0.784	0.845	1.112	0.291	0.595	0.784	0.849	0.942
2	0.269	0.685	0.742	0.950	0.945	0.269	0.685	0.784	0.857	1.114
3	0.324	0.691	0.791	0.860	1.115	0.324	0.691	0.742	0.861	0.962
4	0.401	0.564	0.779	0.944	0.945	0.401	0.564	0.791	0.944	1.115
5	0.291	0.687	0.801	0.835	1.115	0.291	0.687	0.779	0.835	0.942

GRID	9					10				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.411	0.691	0.791	0.944	1.114	0.291	0.595	0.779	0.845	1.142
2	0.269	0.575	0.815	0.812	0.962	0.269	0.685	0.801	0.857	0.922
3	0.32	0.565	0.784	0.942	1.115	0.324	0.691	0.784	0.864	1.112
4	0.317	0.561	0.742	0.944	1.101	0.401	0.564	0.742	0.944	0.945
5	0.411	0.691	0.791	0.895	1.111	0.291	0.687	0.791	0.835	1.121

GRID	11					12				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.291	0.595	0.779	0.845	1.142	0.411	0.695	0.791	0.944	1.01
2	0.269	0.685	0.801	0.857	0.922	0.269	0.575	0.815	0.812	0.942
3	0.324	0.691	0.784	0.864	1.112	0.32	0.565	0.784	0.942	1.114
4	0.401	0.564	0.742	0.944	0.945	0.401	0.561	0.742	0.944	0.962
5	0.291	0.687	0.791	0.835	1.121	0.411	0.691	0.791	0.895	1.115

GRID	13					14				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.291	0.595	0.779	0.845	0.945	0.411	0.69	0.791	0.944	1.112
2	0.269	0.685	0.791	0.857	1.115	0.269	0.575	0.779	0.812	0.945
3	0.324	0.691	0.815	0.86	1.112	0.32	0.565	0.801	0.942	1.115
4	0.401	0.564	0.784	0.944	0.959	0.317	0.561	0.784	0.944	1.112
5	0.291	0.687	0.742	0.835	0.942	0.411	0.691	0.801	0.895	1.01

GRID	15					16				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.401	0.595	0.761	0.845	0.922	0.401	0.69	0.791	0.944	1.121
2	0.411	0.685	0.791	0.857	1.112	0.291	0.575	0.815	0.812	1.01
3	0.291	0.691	0.815	0.86	0.942	0.411	0.565	0.784	0.942	1.101
4	0.269	0.564	0.784	0.944	1.114	0.317	0.561	0.742	0.944	0.942
5	0.324	0.687	0.742	0.835	0.945	0.411	0.691	0.791	0.895	1.114

GRID	17					18				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.291	0.595	0.779	0.845	0.945	0.411	0.69	0.742	0.944	1.112
2	0.269	0.685	0.801	0.857	1.121	0.269	0.575	0.791	0.812	1.01
3	0.324	0.691	0.784	0.86	1.01	0.32	0.565	0.779	0.942	1.112
4	0.401	0.564	0.801	0.944	1.114	0.317	0.561	0.742	0.944	0.942
5	0.291	0.687	0.761	0.835	0.945	0.411	0.691	0.791	0.895	1.114

GRID	19					20				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.291	0.595	0.779	0.845	0.945	0.411	0.69	0.791	0.944	1.114
2	0.269	0.685	0.801	0.857	1.112	0.269	0.575	0.779	0.812	0.945
3	0.324	0.691	0.761	0.86	1.01	0.32	0.565	0.784	0.942	1.112
4	0.401	0.564	0.791	0.944	1.101	0.317	0.561	0.742	0.944	1.01
5	0.291	0.687	0.742	0.835	1.111	0.411	0.691	0.791	0.895	0.922

GRID	21					22				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.291	0.595	0.779	0.845	1.112	0.411	0.69	0.791	0.944	1.01
2	0.269	0.685	0.801	0.857	0.942	0.269	0.575	0.779	0.812	0.989
3	0.324	0.691	0.761	0.86	1.114	0.32	0.565	0.791	0.942	1.111
4	0.401	0.564	0.791	0.944	0.945	0.317	0.561	0.779	0.944	1.142
5	0.291	0.687	0.742	0.835	1.121	0.411	0.691	0.801	0.895	0.922

GRID	23					24				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	0.291	0.595	0.784	0.845	1.112	0.411	0.69	0.801	0.944	1.01
2	0.269	0.685	0.784	0.857	0.942	0.269	0.575	0.761	0.812	1.112
3	0.324	0.691	0.742	0.86	1.114	0.32	0.565	0.815	0.942	0.942
4	0.401	0.564	0.791	0.944	0.945	0.317	0.561	0.784	0.944	1.114
5	0.291	0.687	0.779	0.835	1.112	0.411	0.691	0.742	0.895	0.945

GRID	25				
DEPTH	15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5
1	0.291	0.595	0.815	0.845	1.112
2	0.269	0.685	0.784	0.857	1.01
3	0.324	0.691	0.742	0.86	1.101
4	0.401	0.564	0.791	0.944	1.111
5	0.291	0.687	0.779	0.835	1.114

ANGLE OF FRICTION MEASUREMENTS
RAW DATA ON ANGLE OF FRICTION FOR INDIVIDUAL GRIDS FOR KADE SOIL

GRID	1					2				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	5.27	4.30	5.10	2.35	2.66	5.34	4.49	5.67	2.09	2.62
2	6.39	4.26	5.22	2.57	2.77	5.69	3.45	5.16	2.68	2.71
3	5.65	3.75	4.99	2.49	2.74	4.97	4.29	5.27	3.05	2.79
4	4.74	3.78	5.20	1.97	2.68	5.27	4.34	5.03	1.89	2.73
5	5.00	4.18	5.43	2.35	3.10	6.06	4.10	5.13	2.69	2.81

GRID	3					4				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	6.42	1.69	4.97	2.02	2.92	6.17	4.19	5.39	2.69	2.57
2	7.13	4.08	5.13	2.42	3.10	5.57	3.95	5.22	2.66	2.61
3	5.83	4.00	5.49	2.80	2.65	5.02	4.00	5.27	2.04	2.87
4	5.50	4.12	5.18	3.01	2.88	4.97	4.01	5.30	2.35	3.08
5	5.06	4.09	5.16	2.05	2.88	6.23	4.26	5.34	2.71	2.52

GRID	5					6				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	5.55	3.46	5.03	2.83	2.71	6.30	4.06	5.28	2.72	2.91
2	6.87	4.24	5.01	2.18	2.91	5.32	3.72	5.22	2.74	2.96
3	5.23	4.38	5.33	2.11	2.85	5.19	4.35	5.11	2.15	2.90
4	5.85	4.46	5.60	2.22	2.79	5.39	3.83	5.62	2.56	2.62
5	4.94	3.45	5.18	2.10	2.81	5.60	3.92	5.24	2.46	2.69

GRID	7					8				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	5.40	3.75	5.19	2.89	3.13	5.11	3.78	5.24	2.68	2.91
2	7.81	4.12	5.20	2.76	2.83	5.03	3.72	5.30	2.87	2.84
3	5.09	4.01	4.98	2.63	2.79	5.64	3.99	5.71	2.09	2.74
4	5.39	4.43	4.99	2.10	3.15	5.36	3.72	5.05	2.32	2.71
5	4.97	3.73	5.22	2.48	2.65	6.06	4.03	5.10	2.28	2.56

GRID	9					10				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	5.93	4.00	4.99	2.61	2.93	5.67	4.06	5.43	2.86	2.75
2	7.17	4.15	4.96	2.10	2.97	5.64	3.72	5.10	2.53	2.98
3	5.07	4.41	5.20	2.22	2.94	5.59	4.02	5.18	2.54	2.91
4	5.66	4.18	5.24	2.22	2.84	5.51	4.06	5.14	1.91	2.63
5	6.17	3.33	5.18	2.80	2.61	6.12	4.20	5.41	2.45	3.13

GRID	11					12				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	5.68	3.86	5.18	2.29	2.95	5.79	4.24	5.20	1.87	2.65
2	7.24	4.07	5.02	2.52	2.68	5.80	4.18	5.18	2.76	3.01
3	5.89	4.29	4.97	2.59	2.81	5.83	4.43	4.97	2.24	2.62
4	6.02	4.55	5.17	2.58	2.61	5.22	2.20	5.21	2.41	2.87
5	5.00	3.46	5.22	2.35	2.91	4.93	3.95	5.20	2.11	2.65

GRID	13					14				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	4.99	3.90	4.98	2.25	2.95	4.60	3.73	5.47	2.15	2.83
2	7.47	2.75	4.99	2.45	2.91	5.63	4.18	5.25	2.72	2.69
3	5.05	4.08	5.24	2.26	2.65	5.77	3.94	5.11	1.97	2.95
4	5.22	3.72	5.39	2.48	2.91	5.16	4.35	5.16	2.35	2.91
5	5.23	4.09	5.58	2.49	2.76	6.01	4.05	5.28	1.87	2.65

GRID	15					16				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	5.44	3.90	5.60	2.31	2.98	4.60	1.72	5.11	2.36	2.65
2	7.36	3.47	5.44	2.36	2.91	5.63	4.10	5.32	1.97	2.76
3	4.96	4.05	5.23	2.15	2.56	5.75	3.73	5.04	2.40	3.00
4	5.33	4.10	5.34	2.85	3.13	5.05	4.12	5.41	2.21	2.76
5	5.23	3.84	4.96	2.15	2.61	6.29	3.85	5.38	2.49	2.94

GRID	17					18				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	5.22	4.19	5.36	2.14	2.75	6.07	3.47	5.27	2.17	2.97
2	6.17	3.86	5.19	2.44	2.91	5.74	4.05	5.44	2.31	2.94
3	4.78	4.08	5.14	2.49	2.85	5.32	3.90	5.36	2.35	2.75
4	5.16	4.13	5.21	2.52	2.91	4.99	1.72	5.25	2.61	2.91
5	4.94	4.10	5.49	2.15	2.65	6.40	4.10	5.28	2.44	2.75

GRID	19	20
DEPTH	0-15 CM SAT	0-15 CM SAT

	NORMAL STRESS **(kg/cm²)**					NORMAL STRESS **(kg/cm²)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	7.46	3.73	5.19	2.11	2.95	6.14	3.73	4.98	2.15	2.66
2	5.43	4.04	4.97	2.35	2.61	5.34	4.04	5.17	2.17	2.89
3	6.06	3.82	5.11	2.38	2.94	4.96	3.82	5.18	1.97	2.64
4	4.59	4.21	5.73	2.26	2.89	4.70	4.21	5.10	2.41	2.84
5	7.30	3.96	5.19	2.52	2.62	5.00	3.96	5.50	2.24	2.67

GRID	21					22				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm²)**					NORMAL STRESS **(kg/cm²)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	5.34	3.68	5.33	2.45	2.65	5.63	3.68	5.03	1.97	2.81
2	4.78	4.02	4.99	2.45	2.85	5.18	4.02	5.13	2.49	2.82
3	5.33	1.70	5.27	2.29	2.73	4.99	1.70	4.97	1.95	2.67
4	5.62	4.10	5.16	2.40	2.86	5.33	4.10	5.13	2.45	2.72
5	5.23	3.76	5.23	2.16	2.71	6.23	3.76	5.47	2.52	2.89

GRID	23					24				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm²)**					NORMAL STRESS **(kg/cm²)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	5.14	4.02	4.99	2.44	2.64	5.34	1.70	5.60	2.24	2.77
2	5.12	4.22	5.00	2.31	2.84	5.63	4.10	5.44	2.47	2.82
3	6.90	3.45	5.24	2.29	2.67	5.03	3.76	5.36	2.16	2.68
4	5.60	4.04	5.17	2.40	2.72	5.27	3.93	5.44	2.01	2.86
5	5.05	3.93	5.19	2.21	2.66	5.78	4.01	5.04	2.29	2.66

GRID	25				
DEPTH	0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5
1	5.37	4.02	5.39	2.57	2.77
2	6.90	4.22	5.00	2.45	2.83
3	5.53	3.45	5.09	2.45	2.65
4	5.05	4.04	5.34	2.32	2.67
5	6.03	1.48	5.43	2.47	2.84

GRID	1					2				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	22.80	3.47	4.41	1.62	4.51	23.76	3.56	5.49	1.61	4.36
2	21.85	3.47	5.22	1.56	3.81	22.64	3.56	4.62	1.88	4.42
3	23.51	3.18	5.00	1.42	4.71	23.53	3.45	4.82	1.60	4.61
4	22.93	3.01	5.18	1.77	4.05	25.76	3.20	5.94	1.60	4.05
5	22.87	3.66	4.42	1.33	4.47	21.52	3.09	4.65	1.45	4.37

GRID	3					4				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	20.96	3.71	4.42	1.62	4.51	21.56	3.32	4.37	1.55	4.09
2	23.42	3.27	5.30	1.68	3.81	23.66	3.26	4.86	1.45	3.86
3	21.97	3.58	4.31	1.44	4.16	22.90	3.76	4.99	1.64	4.06
4	22.00	3.09	5.01	1.62	4.05	25.43	3.54	5.01	1.47	3.90
5	23.92	3.27	4.77	1.34	4.42	22.02	3.60	5.32	1.56	4.46

GRID	5					6				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	23.51	3.27	4.46	1.72	4.61	22.21	3.28	5.55	1.95	4.64
2	25.18	3.57	4.33	1.39	4.35	22.64	3.23	5.94	1.52	4.39
3	21.83	3.27	5.05	1.89	4.37	21.87	3.41	4.33	1.70	3.85
4	21.54	2.83	5.49	1.46	4.02	22.90	3.57	4.87	1.37	3.90
5	22.90	3.62	4.62	1.57	4.04	22.51	3.27	4.33	1.50	4.37
GRID	7					8				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	22.15	2.94	4.62	1.57	4.39	22.79	3.58	5.94	1.95	3.81
2	21.91	3.27	4.37	1.46	3.94	25.41	3.52	4.47	1.39	4.02
3	22.90	0.44	4.83	1.77	4.09	21.52	3.30	4.92	1.85	4.34
4	24.37	3.25	4.43	1.47	5.09	22.61	3.83	4.72	1.46	4.64
5	22.02	2.94	4.39	1.55	4.39	23.42	3.27	5.08	1.59	3.90

GRID	9					10				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	21.97	3.55	4.33	1.95	4.09	24.58	3.23	4.81	1.55	4.05
2	23.87	2.97	4.87	1.50	5.09	22.02	3.84	4.15	1.81	4.37
3	22.95	3.23	4.39	1.46	4.39	22.79	3.61	5.32	1.54	4.37
4	21.36	3.18	4.37	1.91	3.81	25.41	3.22	4.77	1.67	4.71
5	21.91	3.01	4.96	1.43	4.71	21.52	2.94	4.37	1.33	4.05

GRID	11	12

DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	22.25	3.21	4.44	1.44	4.41	22.25	3.27	4.52	1.70	4.38
2	21.87	2.98	4.99	1.58	4.40	23.10	3.51	4.92	1.37	4.02
3	23.77	3.25	4.52	1.44	3.86	21.89	3.61	4.33	1.50	3.81
4	21.97	3.83	4.99	1.61	4.61	22.92	3.27	5.32	1.63	4.38
5	22.15	3.41	4.09	1.52	4.05	22.21	2.96	4.96	1.42	4.71

GRID	13					14				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	24.85	3.29	4.42	1.63	4.35	22.25	3.20	4.27	1.39	4.39
2	22.32	3.88	5.28	1.34	4.41	22.95	3.49	4.52	1.44	3.81
3	23.45	3.27	4.20	1.55	3.91	23.00	3.62	5.28	1.55	4.38
4	24.82	3.56	4.37	1.56	4.09	21.52	3.27	4.58	1.34	4.71
5	20.77	3.71	5.76	1.70	5.09	20.67	3.00	5.05	1.59	4.35

GRID	15					16				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	23.13	3.30	4.85	1.59	4.41	20.77	3.23	4.37	1.48	3.81
2	24.85	3.28	4.30	1.56	3.91	23.41	3.01	4.75	1.83	4.02
3	22.32	3.62	4.46	1.41	4.09	22.68	3.29	4.33	1.44	4.37
4	23.45	3.49	5.76	1.50	5.09	24.09	3.76	4.81	1.55	4.40
5	24.82	3.09	4.27	1.58	4.39	23.56	3.28	4.27	1.46	3.86

GRID	17					18				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	24.48	3.62	4.65	1.61	3.81	22.61	3.15	4.60	1.72	4.61
2	23.00	3.49	4.89	1.45	4.02	22.03	3.58	4.37	1.39	3.82
3	22.79	2.92	4.50	1.66	4.37	22.15	3.51	4.77	1.86	3.89
4	25.41	3.62	5.07	1.47	4.40	24.52	3.18	4.86	1.47	4.51
5	21.52	3.55	5.16	1.56	3.86	22.02	2.95	4.33	1.60	3.89

GRID	19					20				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	25.76	3.20	5.18	1.95	4.34	0.231	0.325	0.45	0.458	0.635
2	22.92	3.76	4.98	1.55	5.19	0.221	0.332	0.449	0.461	0.621
3	23.76	3.28	4.41	1.68	3.90	0.199	0.318	0.45	0.459	0.617
4	23.36	3.30	4.37	1.63	4.07	0.219	0.33	0.449	0.471	0.622
5	23.41	3.52	4.09	1.59	4.39	0.22	0.315	0.452	0.461	0.631

GRID	21					22				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	21.12	3.66	4.37	1.47	4.43	25.43	3.66	4.31	1.64	4.36
2	23.42	3.23	4.77	1.55	5.10	21.99	3.34	4.28	1.55	4.42
3	21.24	3.58	4.50	1.50	3.90	21.27	3.52	4.63	1.47	3.91
4	23.42	3.62	4.52	1.60	4.75	22.25	3.47	5.66	1.53	4.05
5	21.87	3.55	5.16	1.91	4.37	22.02	3.14	5.17	1.48	4.37

GRID	23					24				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	22.68	3.22	4.56	1.62	4.43	21.98	3.32	4.46	1.95	3.91
2	24.45	3.26	5.86	1.60	4.38	22.06	3.21	5.24	1.55	4.31
3	21.27	3.44	4.42	1.77	3.91	25.08	3.66	4.87	1.68	4.38
4	25.08	3.58	5.30	1.47	4.35	21.90	3.55	4.81	1.63	4.42
5	21.50	3.30	5.17	1.60	4.41	22.77	3.19	4.56	1.48	4.58

GRID	25				
DEPTH	0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5
1	23.76	3.93	5.86	1.41	3.94
2	22.64	3.27	4.42	1.77	4.36
3	22.90	3.04	4.86	1.33	4.38
4	23.92	3.18	4.81	1.68	4.09
5	22.02	3.35	4.27	1.88	4.09

GRID	1					2				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	28.81	14.96	14.90	13.50	12.80	26.57	15.09	14.73	13.80	12.87
2	26.80	14.18	14.61	13.77	13.11	30.08	14.32	14.65	13.49	14.14
3	27.23	15.29	14.36	13.60	12.20	26.57	15.13	14.42	13.93	12.44
4	29.25	15.01	14.88	13.95	14.03	29.16	15.10	14.74	13.31	13.60
5	29.25	15.31	14.93	14.16	12.47	27.09	14.47	14.99	13.81	12.15

GRID	3					4				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	27.88	14.96	14.71	13.80	13.78	28.33	15.73	14.93	13.90	12.89
2	29.65	15.17	14.92	13.49	12.59	28.65	15.10	14.97	12.76	12.53
3	29.01	15.28	14.41	13.93	12.79	28.53	14.39	14.40	13.43	12.98
4	28.49	15.74	14.75	13.31	12.43	28.68	16.08	14.65	13.70	12.43
5	28.32	15.31	14.65	13.81	13.84	28.69	15.06	14.93	13.65	13.84

GRID	5					6				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	28.43	15.09	14.97	13.46	12.48	28.89	14.86	14.75	13.54	12.55
2	30.19	14.32	14.43	13.97	12.63	29.20	15.32	14.77	13.84	13.73
3	29.60	15.13	14.72	13.08	13.50	28.95	15.15	14.77	13.97	12.35
4	29.04	15.10	15.04	13.36	12.73	29.23	13.66	14.58	12.99	12.75
5	28.88	15.06	14.75	13.93	12.67	29.24	15.15	14.64	13.43	13.84

GRID	7					8				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	28.99	14.45	14.88	12.80	13.09	29.44	15.74	14.91	13.35	13.73
2	30.72	15.23	14.75	13.84	12.44	29.75	15.21	14.79	13.46	12.55
3	29.71	14.79	14.75	13.55	13.60	30.06	15.57	14.42	13.97	13.84
4	29.59	15.17	14.81	13.61	12.24	29.77	15.10	14.74	12.95	12.98
5	29.55	15.28	14.81	13.98	13.06	29.78	15.21	14.80	13.36	12.43

GRID	9	10

DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	29.53	15.25	14.90	13.62	13.60	29.98	15.09	14.58	13.57	13.60
2	31.25	13.59	14.53	13.76	12.47	30.29	14.32	14.93	13.55	12.15
3	30.71	14.39	14.58	13.98	12.87	30.13	15.13	14.77	13.24	12.47
4	30.13	15.20	14.75	13.85	14.14	30.31	14.45	14.91	13.61	12.87
5	29.97	15.06	14.30	13.62	12.44	30.32	15.23	14.83	14.01	12.84

GRID	11					12				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	30.08	14.79	15.06	12.65	13.73	30.51	14.45	14.75	13.31	12.55
2	31.77	15.17	14.77	13.80	12.31	30.82	15.23	14.77	13.57	14.13
3	31.24	15.15	14.72	13.68	13.44	30.66	14.79	14.77	13.70	12.48
4	30.66	14.41	15.04	13.75	12.53	30.84	17.69	14.93	13.24	12.31
5	30.50	15.05	14.75	13.48	12.75	30.85	15.15	14.64	13.61	13.44

GRID	13					14				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	30.61	14.41	14.88	13.96	12.48	31.04	15.33	14.75	13.36	13.84
2	32.29	15.05	14.79	13.24	13.84	31.35	15.22	14.79	13.62	12.89
3	31.76	15.03	14.88	13.95	12.89	31.19	15.01	14.59	13.46	12.44
4	31.19	15.12	14.88	13.73	12.77	31.37	15.31	14.91	13.62	13.60
5	31.03	14.20	14.75	12.95	12.43	31.38	15.57	14.83	13.81	12.43

GRID	15					16				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	31.14	14.79	15.06	13.71	13.84	31.57	17.51	14.73	13.55	12.48
2	32.80	14.91	14.79	12.65	12.89	31.87	15.10	14.79	13.39	13.72
3	32.28	15.37	14.74	13.62	12.77	31.72	15.21	14.81	13.53	12.59
4	31.71	15.15	15.04	13.35	12.31	31.89	14.86	14.57	13.71	13.17
5	31.56	14.25	14.66	13.61	13.44	31.90	15.17	14.86	12.80	12.44

GRID	17					18				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	31.66	17.74	14.90	13.55	12.31	32.09	15.32	14.75	13.93	12.77
2	33.30	15.66	14.95	13.39	13.44	32.39	15.29	14.77	13.39	12.31
3	32.79	15.29	14.75	13.87	12.48	32.23	15.59	14.77	13.55	14.13
4	32.23	15.63	14.52	13.60	13.73	32.41	17.61	15.09	13.39	12.35
5	32.08	14.79	14.93	13.03	12.89	32.42	14.32	14.80	13.57	12.43

GRID	19					20				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	32.18	15.24	14.90	13.60	13.84	32.60	14.94	14.75	13.57	12.84
2	33.80	14.32	14.77	13.92	12.84	32.90	15.23	14.83	13.39	13.60
3	33.30	14.98	14.72	13.54	13.60	32.74	15.22	14.81	13.46	12.47
4	32.74	17.56	14.92	13.48	12.47	32.92	18.11	14.57	13.75	12.55
5	32.59	15.12	14.41	13.62	12.87	32.93	15.20	14.83	13.48	14.13

GRID	21					22				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	32.69	15.72	14.90	13.62	12.48	33.11	15.15	14.75	13.98	12.84
2	34.30	15.28	14.95	13.61	12.63	33.40	17.56	14.83	13.54	13.84
3	33.80	15.74	14.72	13.60	12.44	33.25	15.04	14.41	13.60	12.46
4	33.25	15.21	14.92	13.39	13.60	33.42	15.10	14.93	13.24	13.50
5	33.10	15.57	14.41	13.39	13.50	33.43	15.21	14.83	13.58	12.84

GRID	23					24				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	33.20	14.86	17.94	13.36	13.73	33.61	14.43	14.75	13.62	12.84
2	34.78	14.84	14.79	13.48	12.35	33.90	15.18	14.83	13.42	12.75
3	34.29	15.28	14.37	13.98	12.77	33.75	14.98	14.41	13.98	12.68
4	33.75	15.59	15.04	13.70	12.31	33.92	15.20	14.97	12.95	14.13
5	33.60	17.67	14.77	13.24	12.44	33.93	15.12	14.83	13.81	12.68

GRID	25				
DEPTH	15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5
1	33.70	14.86	14.65	13.77	12.55
2	35.27	15.00	14.79	12.58	12.44
3	34.78	15.29	14.22	13.69	12.63
4	34.24	15.59	14.73	13.58	13.16
5	34.10	15.20	14.81	13.49	13.73

GRID	1					2				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	10.00	14.26	2.44	4.39	0.54	16.40	14.96	2.17	3.25	0.44
2	18.96	13.20	1.97	2.86	2.47	18.83	17.23	3.01	4.93	2.29
3	14.82	16.31	3.12	4.13	0.43	14.70	14.84	2.42	3.01	2.48
4	14.47	18.01	2.71	1.51	2.67	9.30	14.16	1.96	2.98	0.52
5	9.89	18.11	2.48	4.53	0.47	8.73	18.02	2.44	2.32	2.44

GRID	3					4				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	16.51	16.71	3.42	4.34	0.51	9.89	14.98	2.31	1.51	0.51
2	18.96	13.34	2.48	2.75	2.47	11.26	17.75	3.28	4.86	2.45
3	14.60	13.20	2.69	4.18	0.43	17.61	18.01	3.12	3.11	0.43
4	9.88	18.04	2.25	1.62	2.18	13.48	17.60	2.71	3.04	1.69
5	16.40	14.79	2.62	4.48	0.47	13.90	14.67	2.28	2.32	2.47

GRID	5					6				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	10.00	16.71	3.03	4.34	0.52	9.89	14.98	2.31	2.88	2.25
2	17.82	13.34	2.44	4.22	2.24	18.83	17.75	2.58	4.86	0.51
3	17.51	13.20	2.56	2.82	0.41	14.92	18.01	2.28	2.97	0.44
4	14.10	18.04	3.11	2.93	0.42	13.92	17.60	2.48	3.24	2.27
5	10.45	14.79	3.49	3.06	2.45	8.73	14.67	2.02	2.32	2.47

GRID	7					8				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	16.51	16.71	2.44	4.34	0.54	9.89	14.98	2.59	1.52	0.65
2	18.96	13.34	3.28	1.42	2.43	18.83	17.75	2.67	4.86	0.55
3	14.60	13.20	2.47	2.82	0.41	14.92	18.01	2.12	2.36	2.45
4	9.88	18.04	2.71	2.93	2.34	13.92	17.60	2.92	2.93	0.42
5	16.40	14.79	2.28	4.54	0.47	8.73	14.67	2.47	2.21	1.69

GRID	9					10				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	16.51	16.71	2.62	4.34	2.49	9.89	14.96	2.47	2.98	0.51
2	18.96	13.34	2.61	2.86	0.50	18.83	17.75	2.03	4.86	2.26
3	14.60	13.20	3.39	4.11	2.17	14.92	18.01	2.61	1.64	0.50
4	9.88	18.04	2.44	1.51	0.43	13.92	17.60	3.39	2.93	0.65
5	16.40	14.79	2.65	4.53	2.45	8.73	14.67	2.44	2.21	0.54

GRID	11					12				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	16.51	16.71	2.54	3.03	0.20	9.89	14.85	2.46	2.94	1.70
2	18.96	13.34	2.12	4.17	2.70	18.83	17.75	2.01	4.86	2.49
3	14.60	13.20	2.61	2.65	0.47	14.92	18.01	2.62	1.64	0.51
4	9.88	18.04	3.42	2.98	2.36	9.30	17.60	3.41	2.93	2.24
5	16.40	14.79	2.48	4.54	0.40	8.73	14.67	2.46	2.21	0.49

GRID	13					14				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	16.51	16.71	2.67	3.03	2.43	9.89	14.98	2.48	1.62	0.42
2	18.96	13.34	2.31	4.17	0.49	18.83	17.75	2.69	4.81	2.42
3	14.60	13.20	1.96	2.82	0.54	14.92	18.01	2.25	1.53	0.49
4	9.88	18.04	2.61	2.93	2.27	13.92	17.60	2.44	2.98	0.54
5	16.40	14.79	3.42	3.06	2.40	8.73	14.67	2.23	2.32	1.62

GRID	15					16				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	10.56	16.72	3.04	4.34	2.60	10.45	14.89	2.31	1.62	0.43
2	11.39	14.83	2.48	2.75	0.50	17.70	17.75	2.00	4.81	1.71
3	16.36	14.15	2.02	4.18	2.47	9.95	18.01	2.57	1.53	0.66
4	17.02	16.57	2.59	2.98	0.43	13.92	17.60	3.24	2.98	2.47
5	14.65	13.31	3.37	4.54	2.33	8.73	14.67	2.32	3.68	0.50

GRID	17					18				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	16.51	16.71	2.65	4.39	2.45	9.89	14.98	3.42	1.62	0.52
2	18.96	13.34	2.28	4.22	0.32	18.83	17.75	2.48	4.81	1.71
3	14.60	13.20	2.62	4.18	1.70	14.92	18.01	2.69	1.53	0.53
4	9.88	18.04	2.23	2.94	0.52	13.92	17.60	3.37	2.98	2.47
5	16.40	14.79	3.04	4.54	2.45	8.73	14.67	2.42	3.68	0.50

GRID	19					20				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	2.149	1.972	1.907	2.021	2.149	2.162	1.968	1.912	2.021	2.162
2	2.145	1.971	1.911	2.025	2.145	2.15	1.964	1.911	2.015	2.15
3	2.15	1.969	1.917	2.019	2.15	2.152	1.97	1.909	2.025	2.152
4	2.165	1.97	1.912	2.011	2.165	2.162	1.972	1.914	2.017	2.162
5	2.153	1.972	1.914	2.032	2.153	2.144	1.969	1.912	2.021	2.144

GRID	21					22				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	16.51	16.71	2.70	4.39	2.45	9.89	14.98	2.46	1.51	0.50
2	18.96	13.34	2.23	4.22	0.42	18.83	17.75	2.67	4.86	2.45
3	14.60	13.20	3.04	4.18	1.70	14.92	18.01	2.44	1.64	0.53
4	9.88	18.04	2.48	1.62	0.67	13.92	17.60	3.37	2.93	1.69
5	16.40	14.79	3.41	4.48	0.55	8.73	14.67	2.42	2.21	2.70

GRID	23					24				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	16.51	16.71	2.70	4.39	0.54	9.89	14.98	2.29	1.51	1.69
2	18.96	13.34	2.29	4.22	2.47	18.83	17.75	3.05	4.86	0.54
3	14.60	13.20	3.05	4.18	0.93	14.92	18.01	2.00	2.96	2.48
4	9.88	18.04	2.46	1.62	2.42	13.92	17.60	2.57	1.51	0.50
5	16.40	14.79	3.37	4.48	0.43	8.73	14.67	3.36	3.68	2.44

GRID	25				
DEPTH	15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5
1	16.51	16.71	2.01	4.39	0.54
2	18.96	13.34	2.56	2.86	1.69
3	14.60	13.20	3.41	4.13	0.58
4	9.88	18.04	2.48	1.51	0.55
5	16.40	14.79	2.79	4.54	0.51

ANGLE OF FRICTION MEASUREMENTS
RAW DATA ON ANGLE OF FRICTION FOR INDIVIDUAL GRIDS FOR KPONG SOIL

GRID	1					2				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	13.10	7.74	3.08	3.91	3.06	12.87	7.36	3.01	3.78	3.05
2	13.60	7.66	3.15	4.18	3.09	12.88	7.77	3.01	3.95	3.14
3	14.90	7.78	2.86	4.13	3.01	13.31	7.49	3.32	4.05	3.25
4	13.61	5.43	3.15	4.16	3.09	13.13	4.89	3.15	4.22	3.06
5	12.74	7.89	3.15	4.29	3.05	12.43	5.09	3.05	4.15	3.26

GRID	3					4				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	13.39	7.74	3.49	4.20	3.35	12.72	7.72	3.07	2.83	3.01
2	13.77	7.85	3.30	3.93	3.02	12.54	7.38	3.29	4.21	3.03
3	12.73	5.29	3.20	4.13	3.14	12.90	7.78	3.11	4.42	3.08
4	12.87	7.94	3.26	4.16	2.95	13.24	7.75	3.09	4.18	3.06
5	13.27	7.34	3.06	3.83	3.12	12.60	7.80	3.10	3.92	3.14

GRID	5					6				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	12.90	7.86	3.05	4.32	3.12	13.36	7.36	3.05	4.19	3.05
2	13.07	5.37	3.08	4.15	3.25	13.27	7.38	3.11	3.86	3.06
3	13.28	7.86	3.08	4.16	3.16	13.05	7.75	3.26	3.68	3.14
4	13.01	7.41	3.30	3.87	3.36	12.71	5.37	3.09	4.17	3.11
5	12.58	7.78	3.10	4.16	3.01	13.01	7.86	3.29	4.15	3.26

GRID	7					8				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	12.58	7.41	3.19	4.19	3.05	13.06	7.85	3.24	4.19	2.95
2	13.36	7.78	3.11	3.95	3.02	13.26	5.43	3.13	3.94	3.04
3	13.59	5.43	3.05	4.13	3.13	13.01	7.89	3.09	4.16	3.10
4	12.76	7.81	3.09	4.16	3.04	12.57	7.41	3.11	4.16	3.05
5	13.12	7.40	3.03	4.08	3.10	13.45	7.80	3.10	3.83	3.05

GRID	9					10				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	13.77	5.43	3.05	2.83	3.14	13.27	7.89	2.99	3.88	3.09
2	13.28	7.94	3.08	4.21	3.05	13.17	7.41	3.17	3.68	3.14
3	13.12	7.27	3.11	4.42	3.01	12.41	7.78	3.30	4.18	3.29
4	13.61	7.85	3.09	4.16	3.10	13.61	7.74	3.19	4.21	3.10
5	13.07	5.43	3.11	4.16	3.09	13.22	7.80	3.07	4.32	3.13

GRID	11					12				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	12.72	7.74	3.05	4.15	3.19	12.93	7.78	3.19	4.13	3.04
2	13.66	7.85	3.09	4.19	3.17	12.55	7.44	3.26	3.94	3.40
3	13.77	5.38	3.05	3.95	3.16	13.59	7.85	3.19	4.17	3.11
4	12.90	7.94	3.05	4.13	2.82	14.31	7.74	3.03	4.16	3.14
5	13.28	7.41	3.08	4.12	3.04	12.73	7.80	3.24	3.83	3.24

GRID	13					14				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	12.96	7.86	3.13	3.72	3.11	13.12	7.35	3.07	3.81	3.14
2	13.77	5.42	3.13	4.21	3.16	13.60	7.85	3.29	3.95	3.26
3	12.49	7.81	3.11	4.34	3.38	13.61	5.43	3.11	3.88	3.38
4	13.14	7.40	3.01	4.23	3.05	12.74	7.89	3.09	5.00	3.02
5	13.37	7.83	3.09	4.28	3.26	12.87	7.41	3.03	4.17	3.26

GRID	15					16				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	13.75	7.77	3.09	4.19	3.11	13.45	7.35	3.05	3.71	2.99
2	13.23	7.78	3.10	3.93	3.33	13.77	7.83	3.11	4.21	3.22
3	13.10	7.86	3.05	4.13	3.03	12.49	7.57	3.07	4.24	3.11
4	13.28	5.37	3.11	4.16	3.12	12.95	7.81	3.09	4.29	3.31
5	12.57	7.94	3.26	3.88	3.25	13.75	7.40	3.15	3.74	3.02

GRID	17	18

DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	13.28	7.83	3.01	3.92	3.31	13.60	7.41	3.07	3.95	3.07
2	13.12	7.66	3.01	3.91	3.11	13.75	7.89	2.99	4.14	3.23
3	14.04	7.78	3.09	5.04	3.26	13.28	7.41	3.09	4.21	3.38
4	13.77	8.00	3.14	4.12	3.09	13.12	7.78	3.13	3.83	3.02
5	12.33	7.89	3.34	4.15	3.27	13.61	7.52	3.11	3.71	3.26

GRID	19					20				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	12.74	7.86	3.09	4.21	3.11	12.57	7.58	3.01	4.12	3.17
2	12.00	7.41	3.10	4.25	3.33	13.75	7.89	3.01	4.20	3.24
3	13.39	7.89	3.20	5.00	3.05	13.37	7.41	3.11	3.89	3.06
4	12.96	7.41	3.17	4.17	2.95	13.66	7.82	3.15	4.13	3.29
5	12.74	7.78	3.15	4.28	3.29	12.73	7.51	3.05	4.16	3.23

GRID	21					22				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	12.41	7.90	3.10	3.83	3.22	13.11	7.35	3.16	3.71	3.26
2	13.12	7.36	3.26	3.70	3.31	13.75	5.06	3.09	4.19	3.09
3	13.96	7.77	3.19	4.18	3.02	12.58	7.86	3.10	4.29	3.25
4	13.61	7.49	3.07	4.25	3.31	13.12	7.68	3.14	3.91	2.99
5	13.01	7.94	2.99	3.83	3.11	14.18	7.79	3.15	4.32	3.23

GRID	23					24				
DEPTH	0-15 CM SAT					0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	13.66	7.74	3.26	4.15	3.38	12.96	5.11	3.50	3.87	3.31
2	13.06	7.65	3.19	4.19	3.02	13.07	7.63	3.26	3.66	3.02
3	14.04	7.53	3.07	3.91	3.26	13.45	7.74	3.24	4.18	3.31
4	13.77	7.81	2.99	4.14	3.11	13.34	7.71	3.31	4.28	3.13
5	12.76	7.35	3.16	4.16	3.22	12.82	7.53	3.05	4.15	3.19

GRID	25				
DEPTH	0-15 CM SAT				
	NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5
1	12.94	7.69	3.11	3.86	3.06
2	13.09	7.86	3.26	3.70	3.14
3	13.84	5.09	3.05	4.18	3.26
4	13.77	7.68	3.00	4.24	3.09
5	13.54	7.80	2.97	4.03	3.28

GRID	1					2				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	63.67	47.77	29.69	24.97	18.01	63.48	47.68	29.53	24.93	17.94
2	63.64	47.69	29.61	24.94	17.93	63.65	47.62	29.73	25.00	17.82
3	63.88	47.63	29.54	24.98	17.95	63.75	47.55	29.56	24.99	17.79
4	63.69	47.61	29.61	24.92	17.89	63.81	47.76	29.58	24.99	17.92
5	63.64	47.85	29.56	25.08	17.96	63.65	47.81	29.74	24.85	17.87

GRID	3					4				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	63.66	47.60	29.57	24.97	18.00	63.88	47.63	29.54	25.01	17.98
2	63.55	47.75	29.61	25.09	17.94	63.66	47.62	29.71	24.85	17.92
3	63.48	47.87	29.70	24.92	17.94	63.64	47.85	29.54	25.08	17.83
4	63.69	47.71	29.60	25.00	17.97	63.48	47.67	29.58	24.93	17.77
5	63.64	47.68	29.57	24.92	17.88	63.65	47.62	29.52	25.00	17.95

GRID	5					6				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	63.67	47.56	29.86	24.97	18.01	63.64	47.62	29.73	24.93	17.96
2	63.66	47.86	29.61	25.00	17.93	63.48	47.60	29.55	25.02	17.93
3	63.89	47.81	29.61	24.85	17.97	63.66	47.86	29.59	24.97	17.95
4	63.66	47.61	29.57	24.93	17.94	63.64	47.69	29.58	24.99	17.89
5	63.53	47.71	29.54	25.09	17.89	63.88	47.62	29.52	24.85	17.96
GRID	7					8				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	63.69	47.56	29.77	25.01	17.93	63.68	47.60	29.72	24.95	17.92
2	63.64	47.75	30.42	24.97	17.83	63.64	47.85	29.54	24.99	17.82
3	63.68	47.81	29.61	25.09	17.79	63.88	47.69	29.58	24.81	17.79
4	63.48	47.68	29.58	24.93	17.93	63.66	47.61	29.56	24.99	17.94
5	63.80	47.63	29.53	25.01	17.97	63.55	47.55	29.53	24.99	17.88

GRID	9					10				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	63.64	47.60	29.72	24.87	17.97	63.48	47.60	29.68	24.94	17.90
2	63.88	47.82	29.56	24.94	17.91	63.66	47.84	29.55	25.00	17.97
3	63.66	47.68	29.57	25.09	17.83	63.89	47.68	29.55	24.97	17.91
4	63.55	47.68	29.58	24.92	17.78	63.66	47.62	29.57	24.99	17.83
5	63.64	47.63	29.54	25.08	17.95	63.53	47.56	29.54	24.85	17.78

GRID	11					12				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	63.65	47.65	29.73	24.97	17.93	63.48	47.84	29.84	24.95	17.94
2	63.89	47.56	29.54	24.92	17.95	63.91	47.68	29.58	24.87	17.89
3	63.66	47.72	29.58	24.99	17.95	63.66	47.51	29.57	24.92	17.96
4	63.55	47.63	29.58	24.99	18.02	63.53	47.73	29.54	24.95	17.91
5	63.64	47.62	29.53	24.97	17.97	63.64	47.56	29.72	24.97	17.82

GRID	13					14				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	63.49	47.69	29.54	25.01	17.94	63.88	47.58	29.69	24.89	17.95
2	63.65	47.66	29.57	24.95	17.89	63.69	47.81	29.55	24.87	17.89
3	63.88	47.60	29.58	25.00	17.96	63.53	47.69	29.57	25.00	17.97
4	63.82	47.85	29.58	24.83	17.91	63.64	47.87	29.58	24.97	17.92
5	63.64	47.68	29.52	24.97	17.82	63.48	47.84	29.52	24.98	17.82

GRID	15					16				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	63.67	47.77	29.72	24.86	17.78	63.64	47.82	29.69	25.01	17.88
2	63.55	47.61	29.55	24.97	17.94	63.48	47.64	29.57	24.95	17.96
3	63.91	47.73	29.72	24.92	17.99	63.76	47.55	29.59	24.99	17.93
4	63.66	47.60	29.53	24.85	17.97	63.73	47.58	29.55	24.81	17.82
5	63.53	47.69	29.78	24.92	17.95	63.65	47.81	29.73	25.02	17.79

GRID	17					18				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	63.66	47.61	29.53	24.97	17.96	63.66	47.77	29.64	24.94	17.78
2	63.65	47.82	29.60	25.00	17.89	63.65	47.62	29.54	24.88	17.92
3	63.88	47.64	29.70	24.85	17.97	63.78	47.82	29.56	24.97	18.00
4	63.82	47.68	29.59	24.97	17.92	63.71	47.64	29.58	25.00	17.97
5	63.64	47.58	29.53	24.94	17.82	63.65	47.68	29.53	24.99	17.97

GRID	19					20				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	63.66	47.60	29.84	24.97	17.95	63.53	47.68	29.56	24.99	17.79
2	63.65	47.82	29.59	24.96	17.89	63.64	47.60	29.58	24.97	17.93
3	63.88	47.60	29.53	24.99	17.96	63.88	47.78	29.55	24.95	17.97
4	63.82	47.81	29.69	24.99	17.91	63.66	47.65	29.57	24.87	17.92
5	63.64	47.60	29.54	24.86	17.83	63.65	47.81	29.54	24.97	17.82

GRID	21					22				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	63.76	47.69	29.60	24.92	17.77	63.64	47.60	29.58	24.96	17.89
2	63.80	47.60	29.53	24.95	17.94	63.48	47.68	29.55	24.91	17.97
3	63.88	47.81	29.74	24.98	17.95	63.65	47.60	29.55	24.87	17.92
4	63.69	47.61	29.56	24.90	18.02	63.75	47.78	29.58	24.96	17.95
5	63.53	47.81	29.55	24.97	17.94	63.80	47.65	29.54	24.93	17.89

GRID	23					24				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	63.66	47.82	29.72	24.95	17.97	63.64	47.77	29.53	24.84	18.02
2	63.53	47.76	29.54	24.95	17.92	63.69	47.62	29.56	24.98	17.95
3	63.64	47.55	29.56	24.98	17.82	63.52	47.81	29.56	24.93	17.89
4	63.91	47.69	29.58	24.97	17.79	63.87	47.76	29.58	24.97	17.97
5	63.66	47.59	29.56	24.99	17.93	63.71	47.55	29.54	24.99	17.92

GRID	25				
DEPTH	0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5
1	63.54	47.69	29.56	24.86	17.83
2	63.64	47.63	29.59	24.97	17.79
3	63.48	47.60	29.55	24.93	17.93
4	63.82	47.85	29.57	25.01	17.79
5	63.64	47.68	29.56	24.97	17.88

GRID	1					2				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	46.40	29.25	24.88	16.78	14.68	46.45	29.14	24.88	16.87	14.78
2	46.48	29.29	24.91	16.86	14.85	46.53	29.25	24.66	16.71	14.88
3	46.56	29.31	25.05	16.83	14.81	46.47	29.21	24.77	16.83	14.85
4	46.44	29.22	24.94	16.84	14.73	46.15	29.05	24.72	16.78	14.68
5	46.37	29.18	24.89	16.79	14.96	46.59	29.16	24.91	16.92	15.05

GRID	3					4				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	46.48	29.10	24.72	16.83	14.73	46.45	29.14	24.89	16.83	14.72
2	46.31	29.20	24.94	16.76	14.96	46.53	29.23	24.89	16.78	14.96
3	46.54	29.18	24.69	16.86	14.78	46.47	29.18	24.65	16.79	14.78
4	46.45	29.12	20.49	16.87	14.88	46.42	29.14	24.76	16.87	14.87
5	46.37	29.25	24.94	16.94	14.88	46.46	29.27	24.72	16.71	15.09

GRID	5					6				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	46.51	29.19	24.95	16.83	14.73	46.14	29.07	24.94	16.83	14.85
2	46.37	29.06	24.67	16.78	14.85	46.56	29.06	24.89	16.78	14.81
3	46.39	29.09	24.88	16.92	14.81	46.44	29.21	24.90	16.92	14.72
4	46.56	29.08	24.94	16.83	14.73	46.10	29.05	24.66	16.83	14.96
5	46.45	29.08	25.05	16.79	14.68	46.59	29.09	24.76	16.75	14.78

GRID	7					8				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	46.61	29.08	24.72	16.86	14.96	46.09	29.05	24.87	16.92	14.81
2	46.39	29.06	24.88	16.88	14.86	46.54	28.97	24.95	16.83	14.72
3	46.44	29.07	24.77	16.92	14.81	46.44	29.23	24.91	16.75	14.98
4	46.51	29.27	24.94	16.83	14.72	46.13	29.17	24.87	16.86	14.72
5	46.44	29.21	24.69	16.79	14.85	46.58	29.13	24.90	16.87	14.81

GRID	9					10				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	46.58	29.21	24.88	16.92	14.68	46.50	29.33	24.67	16.75	14.72
2	46.37	29.06	24.67	16.83	14.78	46.43	29.07	24.88	16.86	14.85
3	46.45	29.09	24.88	16.78	14.81	46.15	29.07	24.88	16.87	14.81
4	46.53	29.08	24.77	16.92	14.73	46.54	29.26	24.89	16.78	14.72
5	46.44	29.24	24.95	16.83	14.88	46.44	29.21	24.91	16.93	14.86

GRID	11					12				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	46.09	29.06	24.92	16.83	14.81	46.68	29.14	24.65	16.86	14.68
2	46.59	28.98	25.03	16.78	14.72	46.40	29.05	24.77	16.88	14.96
3	46.69	29.07	24.95	16.92	14.87	46.51	28.97	24.72	16.79	14.84
4	46.71	29.24	24.89	16.83	14.73	46.48	29.20	24.93	16.83	14.37
5	46.69	29.27	24.89	16.75	14.81	46.14	29.05	25.03	16.92	14.81

GRID	13					14				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	46.55	28.98	24.95	16.86	14.95	46.47	28.73	24.72	16.84	14.72
2	46.42	29.07	24.89	16.79	14.86	46.12	28.72	24.92	16.79	14.36
3	46.15	29.10	24.89	16.87	14.81	46.54	28.71	24.94	16.87	14.81
4	46.54	29.27	24.65	16.72	14.72	46.48	28.72	24.91	16.71	14.37
5	46.56	28.74	24.77	16.83	14.96	46.14	29.20	25.04	16.86	14.73

GRID	15					16				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	46.55	29.30	24.95	16.71	14.95	46.53	29.20	24.94	16.71	14.81
2	46.76	29.14	24.89	16.83	14.85	46.56	29.26	24.90	16.83	14.72
3	46.59	29.05	24.89	16.78	14.81	46.45	29.14	24.88	17.02	14.96
4	46.45	28.97	24.65	16.78	14.95	46.12	29.06	24.66	16.79	14.37
5	46.14	29.20	25.05	16.87	14.85	46.54	29.15	24.75	17.02	14.68

GRID	17					18				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	46.45	29.27	24.72	16.78	14.95	46.53	29.18	24.90	16.87	14.68
2	46.55	29.21	24.88	16.85	14.86	46.54	29.14	24.87	16.97	14.95
3	46.45	29.05	24.93	16.84	14.81	46.47	29.27	24.68	16.83	14.72
4	46.10	29.31	25.04	16.84	14.73	46.10	29.21	24.75	16.78	14.96
5	46.58	29.22	24.94	16.86	14.96	46.59	29.05	24.73	16.86	14.38

GRID	19					20				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	46.45	29.32	25.03	16.83	14.36	46.60	29.14	24.76	16.77	14.95
2	46.09	29.23	24.95	16.84	14.85	46.48	29.27	24.72	16.92	14.78
3	46.54	29.18	24.89	16.86	14.81	46.43	29.21	25.03	16.86	14.96
4	46.92	29.14	24.90	16.71	14.72	46.41	29.05	24.75	16.83	14.89
5	46.47	29.18	24.65	16.83	14.68	46.51	29.32	24.95	16.85	14.68

GRID	21					22				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	46.45	29.23	24.88	16.71	14.95	46.53	29.05	24.66	16.71	14.69
2	46.56	29.18	24.92	16.83	14.82	46.48	29.21	24.94	16.85	14.93
3	46.43	29.14	25.03	16.78	14.96	46.10	29.18	24.89	16.78	14.38
4	46.42	29.27	24.90	16.92	14.73	46.52	29.14	24.88	16.92	11.54
5	46.44	29.21	24.91	16.87	14.72	46.43	29.27	24.66	16.84	14.68

GRID	23					24				
DEPTH	15-30 CM SAT					15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	46.43	29.20	24.75	16.71	15.06	46.41	29.14	24.68	16.85	14.72
2	46.45	29.05	24.73	16.83	14.72	46.56	29.33	24.77	16.79	14.64
3	46.56	29.31	24.88	16.78	14.96	46.47	29.22	24.91	16.87	14.96
4	46.43	29.23	24.89	16.92	14.96	46.12	29.18	24.89	16.71	14.68
5	46.43	29.19	24.91	16.83	14.81	46.38	29.13	24.94	16.85	14.95

GRID	25				
DEPTH	15-30 CM SAT				
	NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5
1	46.40	29.28	24.90	16.78	14.73
2	46.51	29.20	24.76	16.92	14.96
3	46.48	29.05	24.95	16.84	14.81
4	46.14	29.19	24.67	16.84	14.73
5	46.61	29.09	24.90	16.88	14.68

GRID	1					2				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	44.16	25.39	4.75	5.72	4.68	44.08	25.50	4.74	5.68	4.70
2	44.22	25.41	4.78	5.74	4.71	44.32	25.58	4.53	5.75	4.59
3	44.32	25.41	4.59	5.73	4.63	44.12	25.40	4.73	5.71	4.80
4	44.07	25.40	4.83	5.71	4.73	44.20	25.29	4.79	5.73	4.69
5	44.25	25.40	4.74	5.57	4.68	44.22	25.47	4.46	5.52	4.69

GRID	3					4				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	44.07	25.80	4.70	5.73	4.78	44.37	25.45	4.55	5.77	4.53
2	44.30	25.37	4.50	5.74	4.70	44.10	25.40	4.76	5.77	4.64
3	44.01	25.60	4.80	5.73	4.71	44.32	25.87	4.67	5.71	4.71
4	44.21	25.43	4.76	5.71	4.69	44.16	25.35	4.78	5.57	4.67
5	44.07	25.92	4.74	5.74	4.55	44.08	25.47	4.77	5.68	4.71

GRID	5					6				
DEPTH	0-15 CM UNSAT					0-15 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	44.30	25.41	4.77	5.78	4.59	44.09	25.73	4.70	5.76	4.70
2	44.12	25.52	4.79	5.71	4.77	44.24	25.34	4.53	5.77	4.71
3	44.10	25.49	4.82	5.73	4.66	44.12	25.38	4.82	5.71	4.68
4	44.20	25.46	4.80	5.58	4.72	44.19	25.60	4.80	5.73	4.64
5	44.17	25.53	4.73	5.72	4.64	44.10	25.43	4.67	5.76	4.71

GRID	7					8				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	44.32	25.92	4.54	5.71	4.67	44.29	25.51	4.67	5.77	4.73
2	44.16	25.45	4.79	5.74	4.69	44.07	25.41	4.75	5.77	4.70
3	43.96	25.40	4.79	5.75	4.59	44.25	25.41	4.52	5.71	4.72
4	44.32	25.87	4.82	5.71	4.77	44.14	25.59	4.72	5.72	4.57
5	44.09	25.42	4.80	5.74	4.70	44.11	25.38	4.77	5.71	4.74

GRID	9					10				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	44.20	25.97	4.59	5.59	4.69	44.34	25.48	4.70	5.56	4.69
2	44.29	25.48	4.76	5.65	4.73	44.13	25.34	4.79	5.75	4.55
3	44.18	25.34	4.74	5.78	4.69	44.20	25.38	4.74	5.39	4.72
4	44.27	25.82	4.80	5.72	4.69	44.34	25.61	4.72	5.58	4.69
5	44.27	25.39	4.73	5.72	4.68	44.05	25.43	4.77	5.74	4.70

GRID	11					12				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	44.04	25.96	4.41	5.71	4.68	44.30	25.48	4.70	5.86	4.70
2	44.22	25.43	4.80	5.82	4.55	44.12	25.38	4.72	5.55	4.54
3	44.10	25.35	4.38	5.75	4.72	44.12	25.38	4.88	5.71	4.69
4	44.27	25.87	4.80	5.72	4.69	44.30	25.35	4.79	5.82	4.69
5	44.27	25.42	4.73	5.74	4.72	44.19	25.41	4.69	5.66	4.69

GRID	13					14				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	44.22	25.41	4.70	5.79	4.70	44.32	25.34	4.78	5.65	4.69
2	44.21	25.59	4.77	5.72	4.53	44.16	25.40	4.48	5.71	4.70
3	44.18	25.38	4.74	5.72	4.70	44.11	25.40	4.67	5.75	4.69
4	44.37	25.97	4.82	5.56	4.70	44.28	25.48	4.78	5.86	4.71
5	44.28	25.48	4.73	5.76	4.67	44.32	25.38	4.41	5.55	4.74

GRID	15					16				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	44.16	25.61	4.78	5.71	4.68	44.34	25.45	4.77	5.76	4.70
2	44.10	25.45	4.65	5.80	4.66	44.13	25.40	4.80	5.77	4.70
3	44.30	25.84	4.84	5.65	4.70	44.20	25.45	4.46	5.71	4.72
4	44.34	25.38	4.78	5.77	4.65	44.19	25.34	4.71	5.73	4.68
5	44.29	25.41	4.61	5.73	4.65	44.16	25.48	4.87	5.73	4.56

GRID	17					18				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	44.21	25.39	4.80	5.75	4.70	44.30	25.50	4.77	5.68	4.69
2	44.28	25.41	4.61	5.87	4.62	44.13	25.34	4.80	5.77	4.68
3	44.20	25.41	4.75	5.56	4.64	44.27	25.40	4.67	5.71	4.54
4	44.37	25.40	4.82	5.71	4.75	44.30	25.40	4.52	5.73	4.78
5	44.27	25.40	4.67	5.80	4.54	44.13	25.48	4.71	5.76	4.70

GRID	19					20				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	44.27	25.42	4.88	5.72	4.71	44.30	25.43	4.70	5.73	4.54
2	44.22	25.41	4.72	5.66	4.75	44.12	25.54	4.77	5.81	4.72
3	44.18	25.48	4.65	5.72	4.68	44.29	25.44	4.82	5.68	4.69
4	44.33	25.43	4.77	5.85	4.53	44.34	25.41	4.67	5.77	4.56
5	44.28	25.38	4.74	5.56	4.67	44.13	25.45	4.77	5.71	4.79

GRID	21					22				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	44.18	25.47	4.60	5.72	4.72	44.18	25.26	4.72	5.81	4.57
2	44.22	25.48	4.74	5.53	4.72	44.35	25.36	4.81	5.63	4.65
3	44.20	25.36	4.72	5.73	4.64	44.31	25.42	4.84	5.77	4.72
4	44.31	25.42	4.80	5.71	4.69	44.32	25.44	4.67	5.71	4.69
5	44.31	25.44	4.73	5.74	4.68	44.19	25.43	4.75	5.76	4.69

GRID	23					24				
DEPTH	15-30 CM UNSAT					15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**					NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
1	44.22	25.26	4.65	5.72	4.69	44.31	25.45	4.57	5.77	4.69
2	44.19	25.36	4.76	5.76	4.57	44.03	25.38	4.50	5.77	4.69
3	44.20	25.42	4.73	5.52	4.77	44.32	25.39	4.83	5.71	4.70
4	44.31	25.44	4.77	5.72	4.70	44.29	25.45	4.74	5.66	4.65
5	44.31	25.43	4.61	5.72	4.73	44.12	25.56	4.67	5.79	4.66

GRID	25				
DEPTH	15-30 CM UNSAT				
	NORMAL STRESS **(kg/cm^2)**				
REPLICATES	T1	T2	T3	T4	T5
1	44.23	25.45	4.75	5.72	4.73
2	44.34	25.27	4.59	5.51	4.69
3	44.19	25.45	4.67	5.63	4.72
4	44.18	25.38	4.79	5.74	4.71
5	44.33	25.35	4.46	5.82	4.69

Appendix C
ANOVA Tables
SHEAR STRESS
Results for variance test for Kade 0-15 cm saturated

Variate: SHEAR

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	2.805E+00	7.012E-01	84517.11	<.001
Residual	120	9.956E-04	8.297E-06		
Total	124	2.806E+00			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

Results for variance test for Kade 0-15 cm unsaturated

Variate: SHEAR

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	3.98320051	0.99580013	23427.22	<.001
Residual	120	0.00510073	0.00004251		
Total	124	3.98830125			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

Results for variance test for Kade 15-30 cm saturated

Variate: SHEAR

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	47.8922917	11.9730729	24591.37	<.001
Residual	119	0.0579389	0.0004869		
Total	123	47.9502306			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

Results for variance test for Kade 15-30 cm unsaturated

Variate: SHEAR

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	6.39793137	1.59948284	19423.39	<.001
Residual	120	0.00988179	0.00008235		
Total	124	6.40781316			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

Results for variance test for Kpong 0-15 cm saturated

Variate: SHEAR

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	2.715E+00	6.787E-01	2.426E+05	<.001
Residual	120	3.357E-04	2.797E-06		
Total	124	2.715E+00			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

Results for variance test for Kpong 0-15 cm unsaturated

Variate: SHEAR

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	1.977E+00	4.944E-01	4.521E+06	<.001
Residual	120	1.312E-05	1.094E-07		
Total	124	1.977E+00			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

Results for variance test for Kpong 15-30 cm saturated

Variate: SHEAR

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	8.00165517	2.00041379	85087.51	<.001
Residual	120	0.00282121	0.00002351		
Total	124	8.00447638			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

Results for variance test for Kpong 15-30 cm unsaturated

Variate: SHEAR

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	1.165E+00	2.913E-01	61050.00	<.001
Residual	120	5.726E-04	4.772E-06		
Total	124	1.166E+00			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

COHESION

Results for variance test for Kade 0-15 cm saturated

Variate: COHESION

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	1.76061657	0.44015414	17195.17	<.001
Residual	120	0.00307171	0.00002560		
Total	124	1.76368827			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

Results for variance test for Kade 0-15 cm unsaturated

Variate: COHESION

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	7.33663412	1.83415853	41888.06	<.001
Residual	120	0.00525446	0.00004379		
Total	124	7.34188857			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

Results for variance test for Kade 15-30 cm saturated

Variate: COHESION

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	20.6593476	5.1648369	42836.23	<.001
Residual	120	0.0144686	0.0001206		
Total	124	20.6738162			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

Results for variance test for Kade 15-30 cm unsaturated

Variate: COHESION

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	1.3851874	0.3462969	2151.59	<.001
Residual	120	0.0193140	0.0001609		
Total	124	1.4045014			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

Results for variance test for Kpong 0-15 cm saturated

Variate: COHESION

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	2.17986209	0.54496552	13515.39	<.001
Residual	120	0.00483862	0.00004032		
Total	124	2.18470071			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

Results for variance test for Kpong 0-15 cm unsaturated

Variate: COHESION

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	2.328E+00	5.821E-01	69806.40	<.001
Residual	120	1.001E-03	8.339E-06		
Total	124	2.329E+00			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

Results for variance test for Kpong 15-30 cm saturated

Variate: COHESION

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	3.65339494	0.91334873	17510.12	<.001
Residual	120	0.00625934	0.00005216		
Total	124	3.65965428			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

Results for variance test for Kpong 15-30 cm unsaturated

Variate: COHESION

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	1.165E+00	2.912E-01	61291.29	<.001
Residual	120	5.702E-04	4.751E-06		
Total	124	1.165E+00			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

ANGLE OF FRICTION

Results for variance test for Kade 0-15 cm saturated

Variate: ANGLE OF FRICTION

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	204.46357	51.11589	1877.62	<.001
Residual	120	3.26685	0.02722		
Total	124	207.73041			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

Results for variance test for Kade 0-15 cm unsaturated

Variate: ANGLE OF FRICTION

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	7662.87502	1 15.71875	33369.10	<.001
Residual	120	6.88919	0.05741		
Total	124	7669.76421			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

Results for variance test for Kade 15-30 cm saturated

Variate: ANGLE OF FRICTION

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	5883.1422	1470.7856	1865.51	<.001
Residual	120	94.6090	0.7884		
Total	124	5977.7513			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

Results for variance test for Kade 15-30 cm unsaturated

Variate: ANGLE OF FRICTION

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	4828.2331	1207.0583	3266.84	<.001
Residual	120	44.3386	0.3695		
Total	124	4872.5717			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

Results for variance test for Kpong 0-15 cm saturated

Variate: ANGLE OF FRICTION

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	1839.10428	459.77607	14949.75	<.001
Residual	120	3.69057	0.03075		
Total	124	1842.79485			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

Results for variance test for Kpong 0-15 cm unsaturated

Variate: ANGLE OF FRICTION

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	3.474E+04	8.686E+03	8.321E+06	<.001
Residual	120	1.253E-01	1.044E-03		
Total	124	3.474E+04			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

Results for variance test for Kpong 15-30 cm saturated

Variate: ANGLE OF FRICTION

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	1.596E+04	3.991E+03	2.779E+05	<.001
Residual	120	1.723E+00	1.436E-02		
Total	124	1.597E+04			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

Results for variance test for Kpong 15-30 cm unsaturated

Variate: ANGLE OF FRICTION

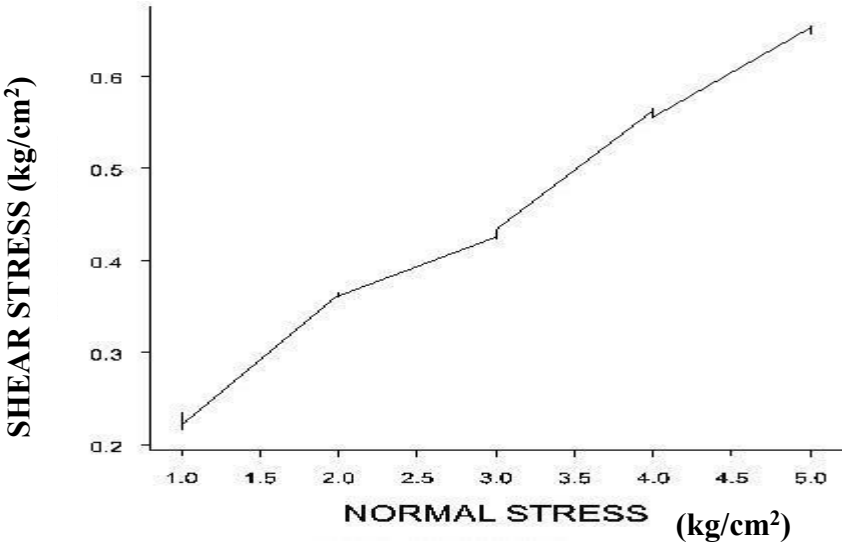
Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
TREATMENT	4	3.106E+04	7.766E+03	3.821E+06	<.001
Residual	120	2.439E-01	2.032E-03		
Total	124	3.106E+04			

SS= Sum of squares; df= degree of freedom; ms= Mean of squares; v.r= variance raio; F pr.= P value

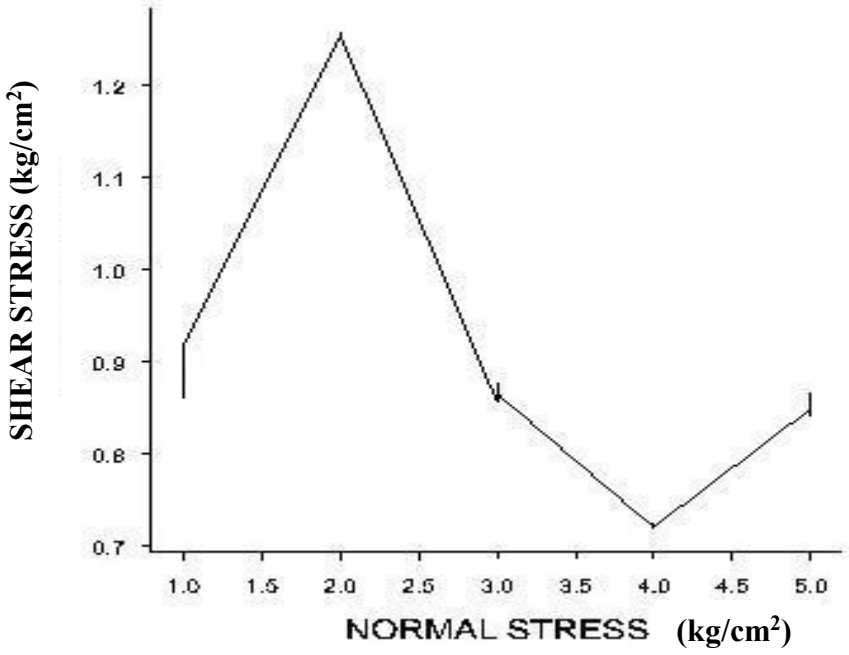
Appendix C

GRAPHS

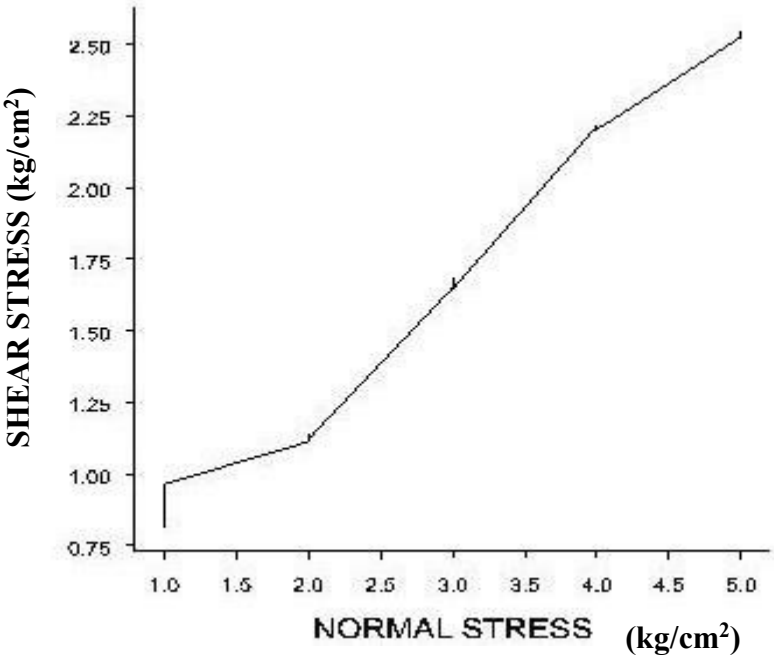
SHEAR STRESS



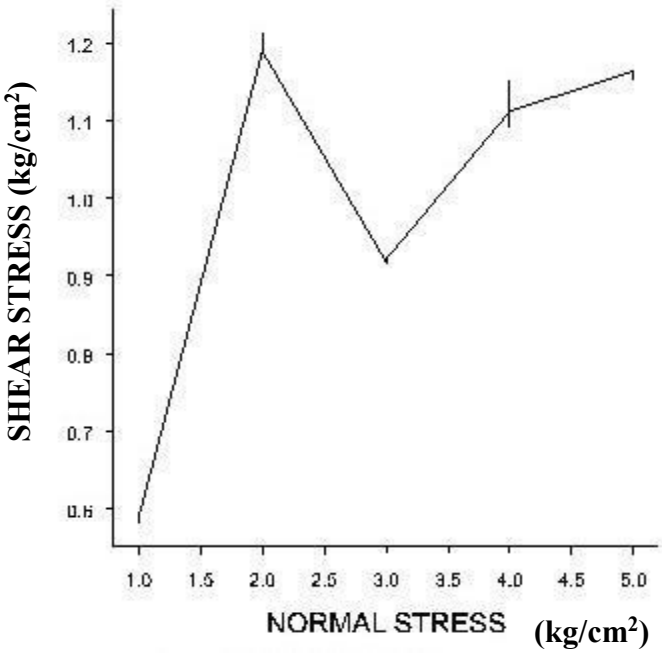
Graph of shear stress against normal stress at 0-15 cm under saturated condition of Kade soil



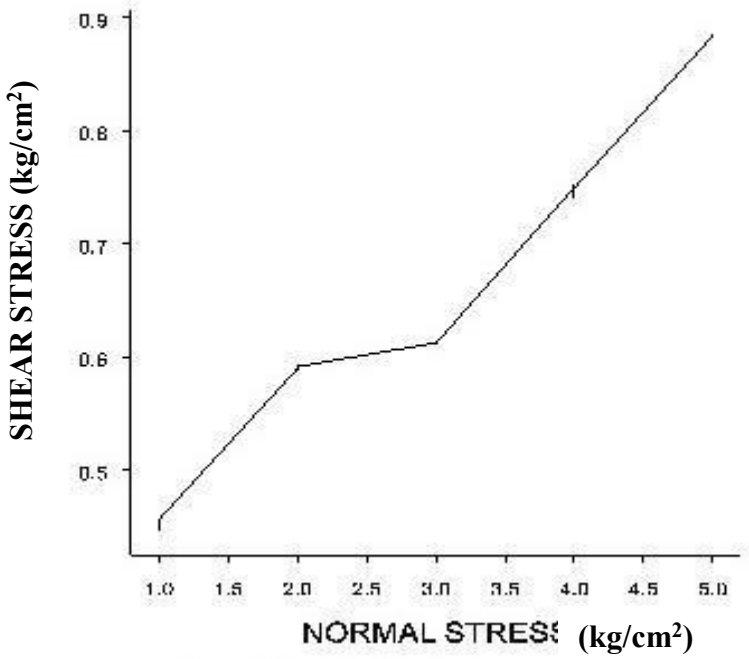
Graph of shear stress against normal stress at 0-15 cm under unsaturated condition of Kade soil



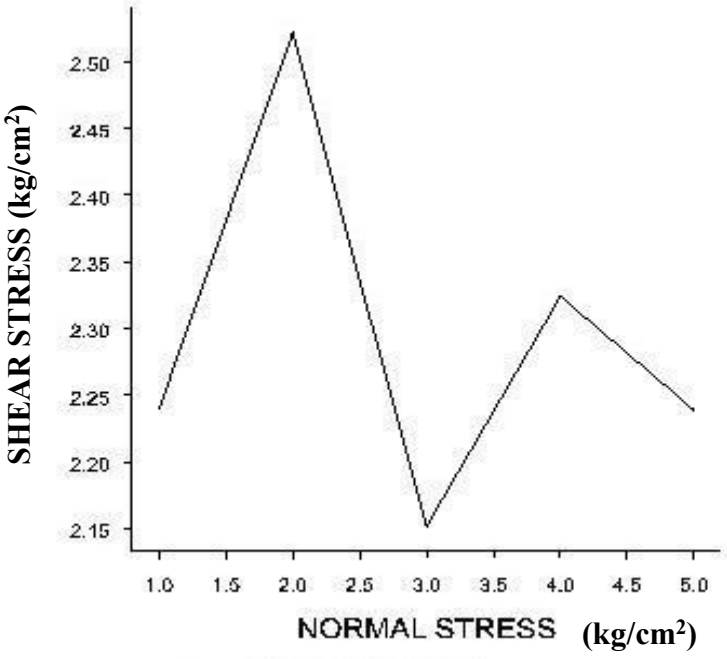
Graph of shear stress against normal stress at 15-30 cm under saturated condition of Kade soil



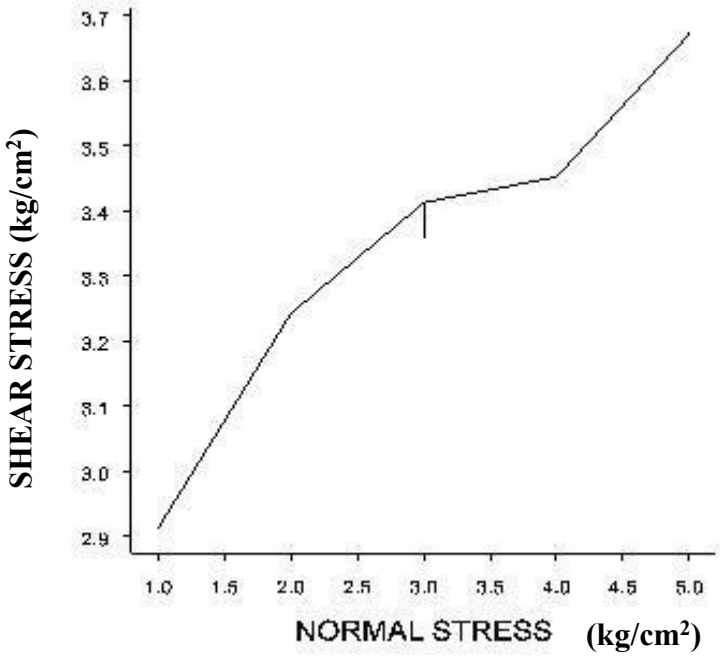
Graph of shear stress against normal stress at 15-30 cm under unsaturated condition of Kade soil



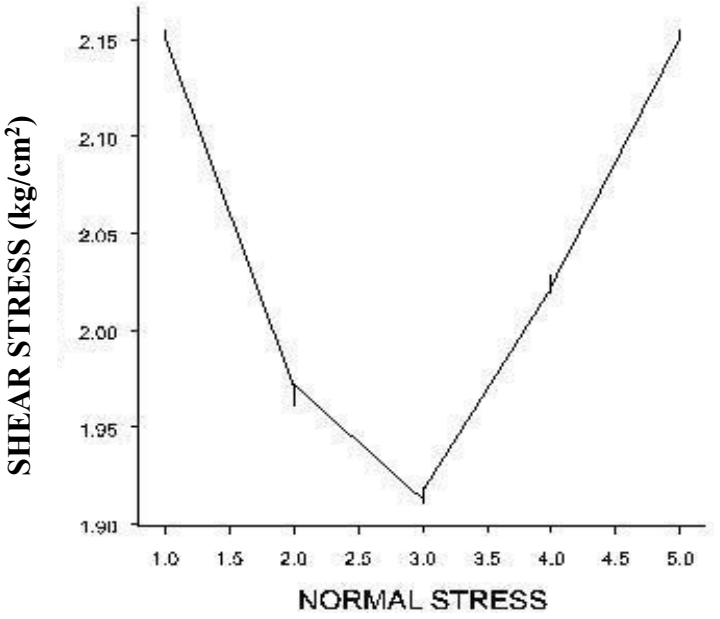
Graph of shear stress against normal stress at 0-15 cm under saturated condition of Kpong soil



Graph of shear stress against normal stress at 0-15 cm under unsaturated condition of Kpong soil

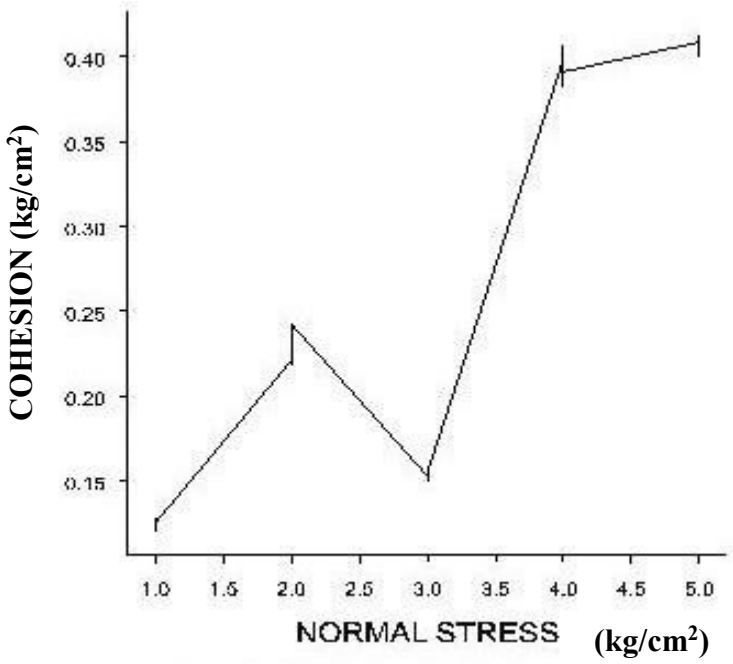


Graph of shear stress against normal stress at 15-30 cm under saturated condition of Kpong soil

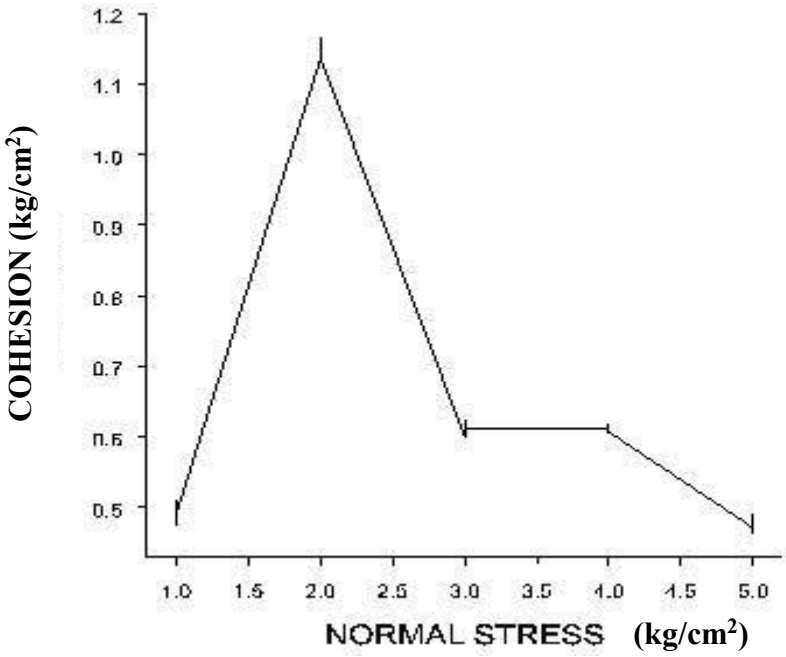


Graph of shear stress against normal stress at 15-30 cm ur ated condition of Kpong soil

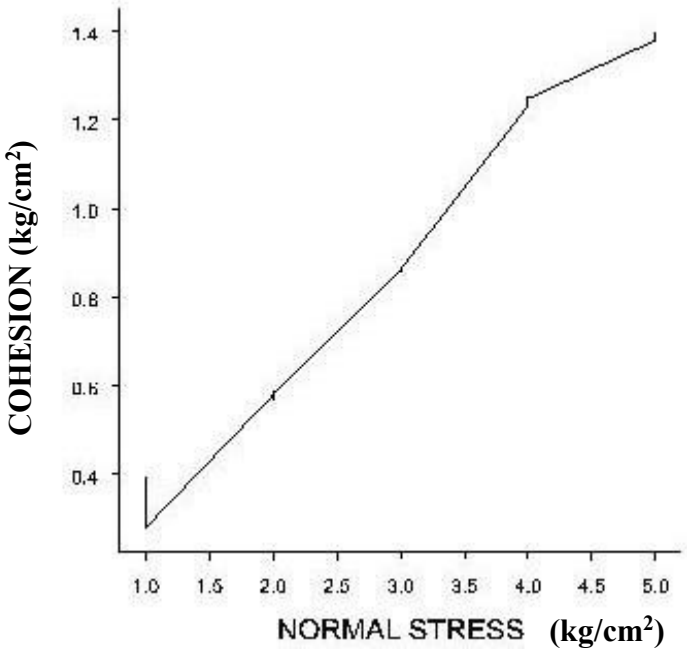
<u>COHESION</u>



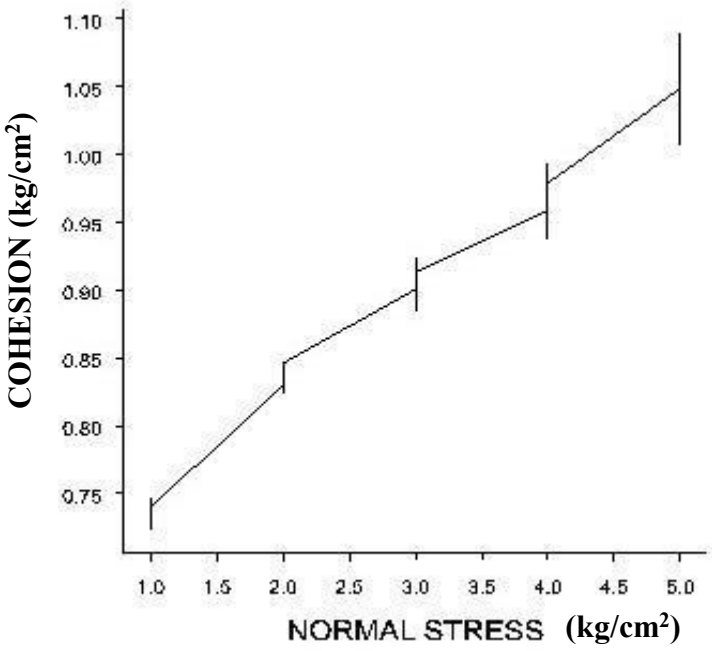
Graph of cohesion against normal stress at 0-15 cm under saturated condition of Kade soil



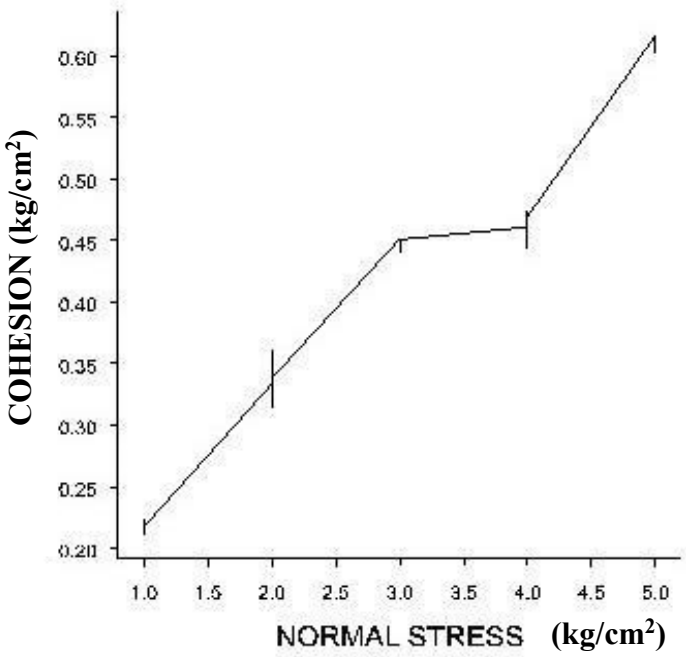
Graph of cohesion against normal stress at 0-15 cm under unsaturated condition of Kade soil



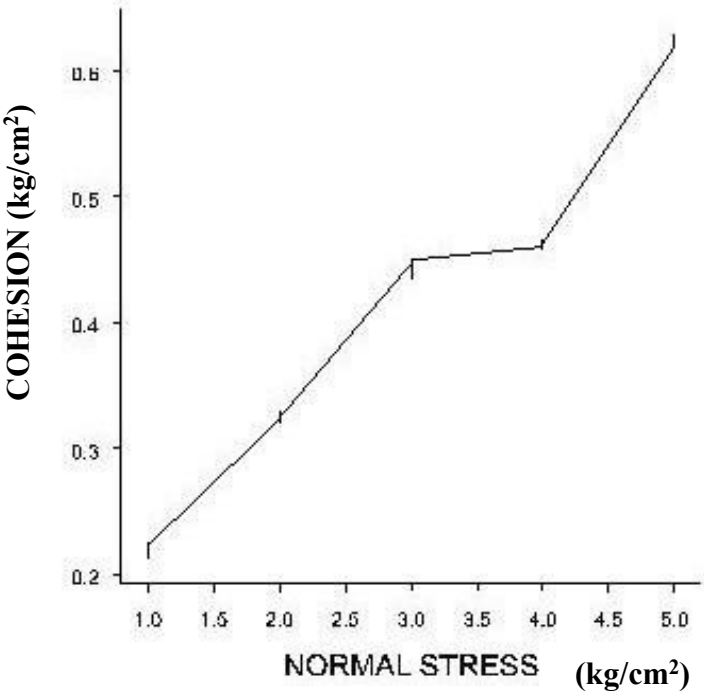
Graph of cohesion against normal stress at 15-30 cm under saturated condition of Kade soil



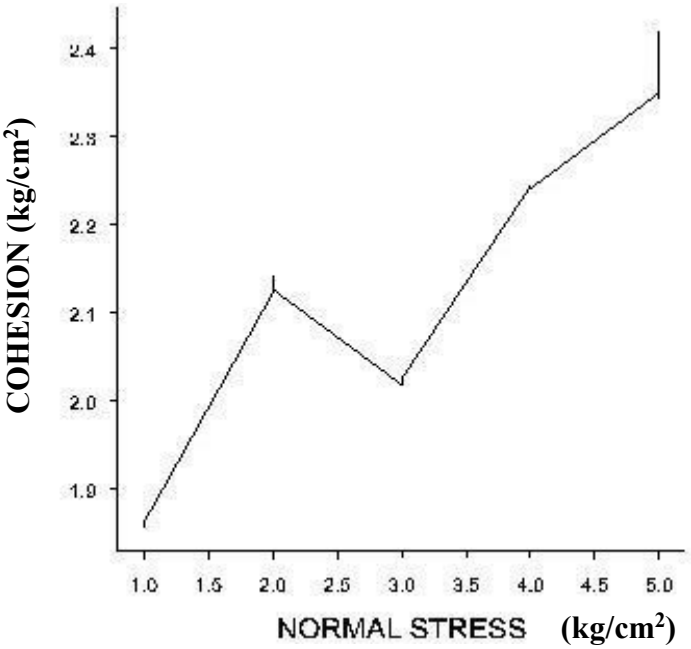
Graph of cohesion against normal stress at 15-30 cm under unsaturated condition of Kade soil



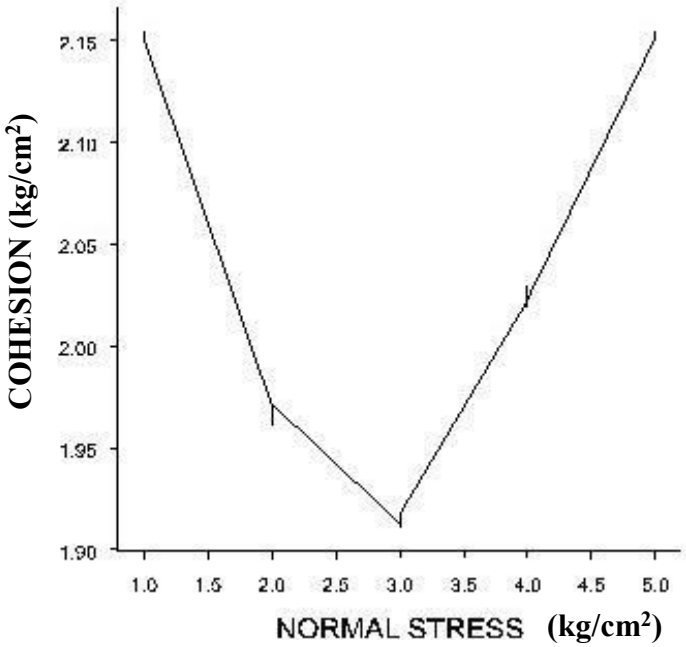
Graph of cohesion against normal stress at 0-15 cm under saturated condition of Kpong soil



Graph of cohesion against normal stress at 0-15 cm under unsaturated condition of Kpong soil

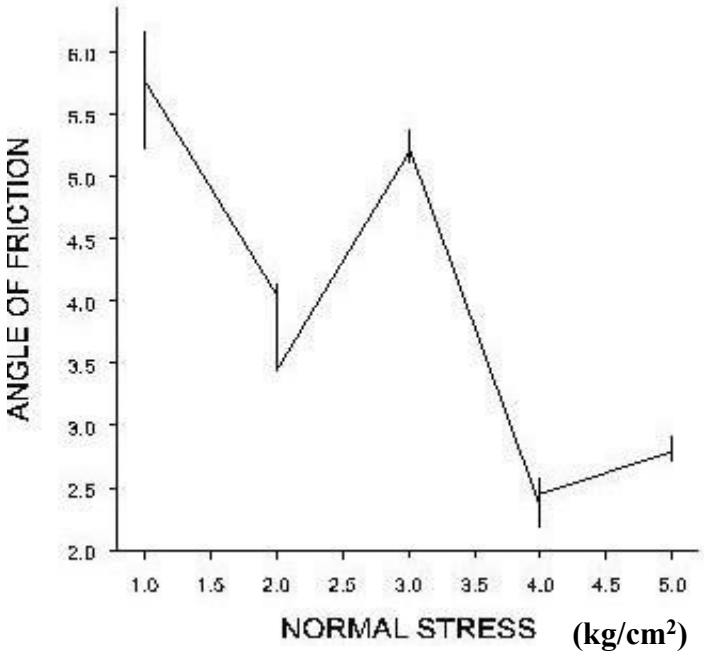


Graph of cohesion against normal stress at 15-30 cm under saturated condition of Kpong soil

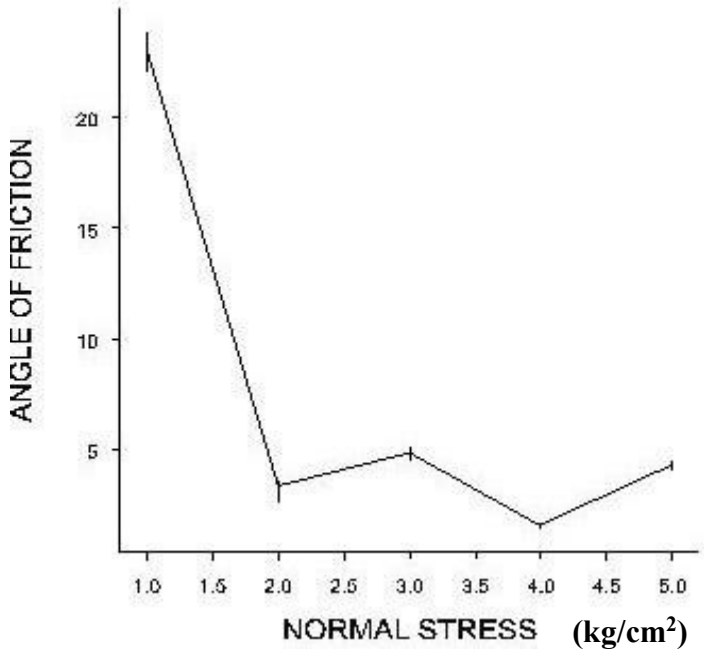


Graph of cohesion against normal stress at 15-30 cm under unsaturated condition of Kpong soil

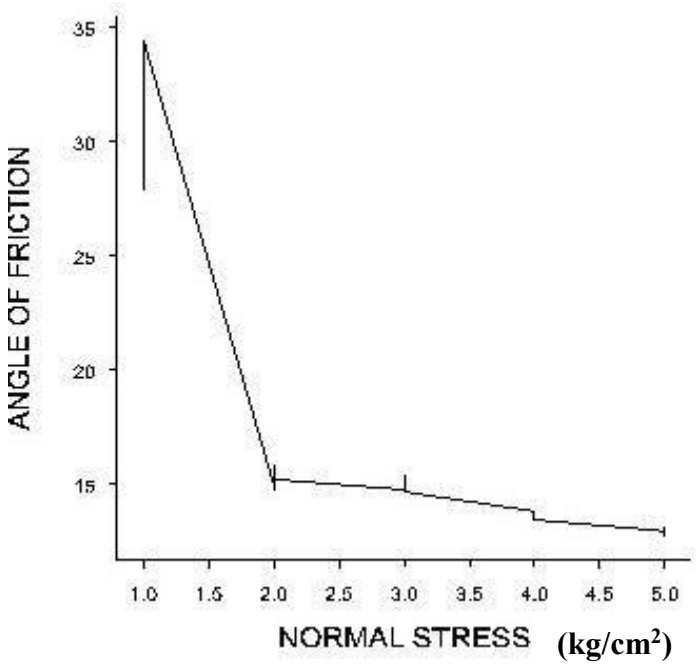
ANGLE OF FRICTION



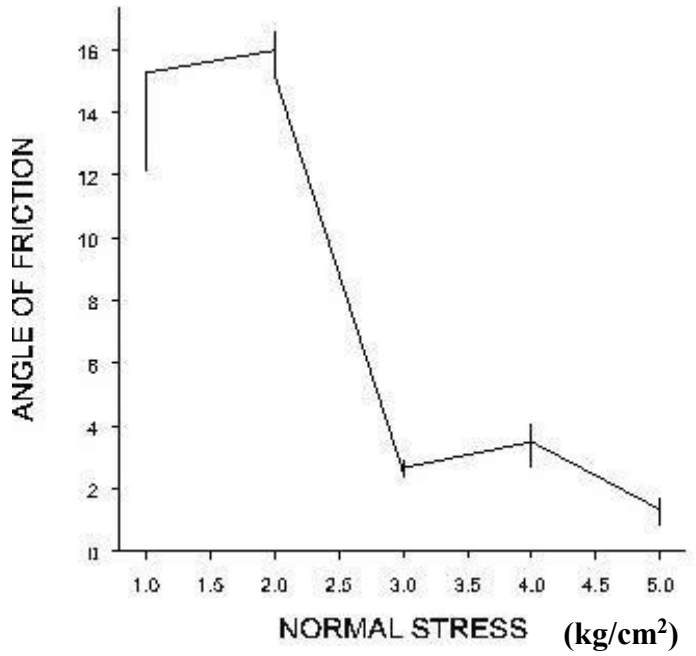
Graph of angle of friction against normal stress at 0-15 cm under saturated condition of Kade soil



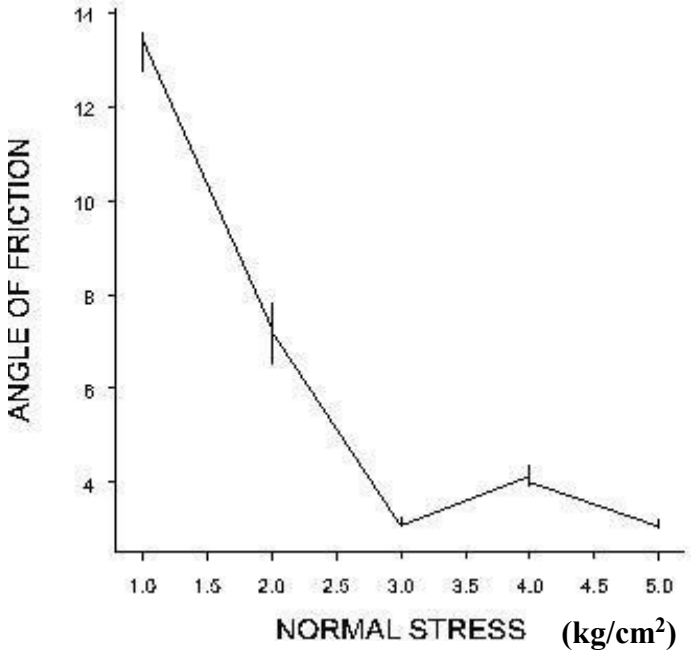
Graph of angle of friction against normal stress at 0-15 cm under unsaturated condition of Kade soil



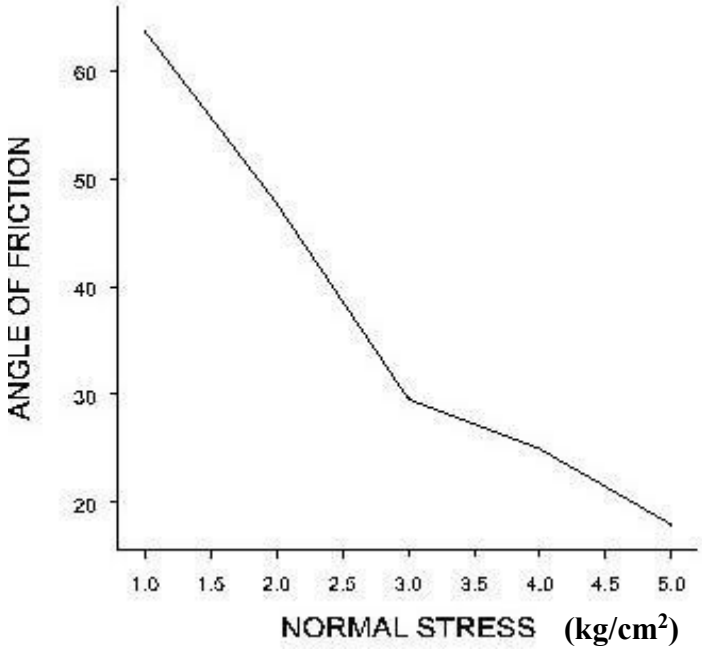
Graph of angle of friction against normal stress at 15-30 cm under saturated condition of Kade soil



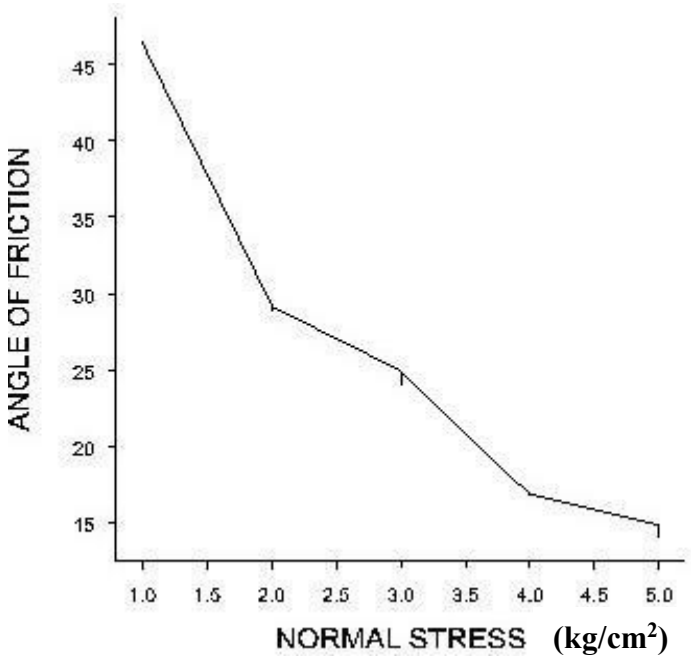
Graph of angle of friction against normal stress at 15-30 cm under unsaturated condition of Kade soil



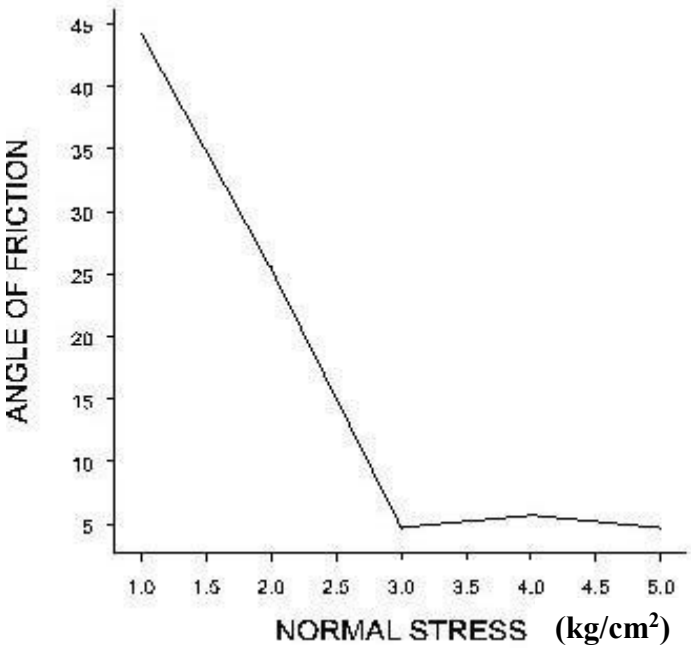
Graph of angle of friction against normal stress at 0-15 cm under saturated condition of Kpong soil



Graph of angle of friction against normal stress at 0-15 cm under unsaturated condition of Kpong soil



Graph of angle of friction against normal stress at 15-30 cm under saturated condition of Kpong soil



Graph of angle of friction against normal stress at 15-30 cm under unsaturated condition of Kpong soil