Progress and Completion Report
Oklahoma State University Center for Water Research.
Research Grant: Account No. 1-1-50626
June 13, 1986

E-042

Title

Development of powered installation device for neutron access tubes for soil moisture measurement.

Project Leaders

J. F. Stone and M. E. Hodges

Purpose

To acquire a device designed to install soil access tubes for measurement of soil water content by neutron scattering soil moisture meters and the system is to provide measurements to a depth of ten feet.

Several OSU soil water studies have been limited by the depth to which the neutron meters access tubes can be installed manually. Most of these studies have permitted measurements to four feet in the soil. In studies of plants in rainfed conditions we are finding that roots commonly extract water below the four foot depth. There was no powered device on the market to permit installation of access tubes to as deep as ten feet. Thus we proposed to obtain such a device through design or contract.

Procedure

The Giddings Company, Ft. Collins, CO was known to market a device to take soil sample cores to a depth of ten feet or greater. They were contacted shortly after the initiation of the grant in summer of 1985 to see if they felt our project was feasible. They felt it was feasible.

Mr. Hodges went to Ft. Collins in late August of 1985 to develop the design and performance. The Giddings people felt our need could be met by suitable modification of a catalogue listed machine. We then developed a specification sheet (copy appended) and the item went out for bid. We required that the satisfactory performance be demonstrated at the factory and, if successful, we would then accept the device and transport it to Stillwater. The Giddings Machine Company was the only bidder. They developed the design and were ready for inspection and delivery by late April 1986. Mr. Hodges went to Ft. Collins on May 5, 1986 and after some minor modifications the device was deemed to perform according to specifications. We took delivery. On the return trip to Stillwater, Mr. Hodges stopped at the Oklahoma Agricultural Experiment Station research site at Goodwell, Oklahoma and demonstrated that the device would work well in that soil (on which we do many water use studies). This included insertation of tubes through a caliche layer. This layer has previously been a limiting factor in the installation of access tubes. The device functioned satisfactorily. The device was subsequently demonstrated in Stillwater on May 29, 1986. The device is now ready for use in field studies.

Performance of Access Tube Installation Device

The figures show views of the operation of the device at the Stillwater test on May 29, 1986. In Fig. 1 the device is shown mounted on the 3-wheeled transportation cart and is in position to be transferred to tractor for use at the field site. When mounted on the 3-wheeled cart the device can be transported in a pick-up truck to the field site anywhere in the state. A universal electric winch (Fig. 2) can be quickly mounted on any pick-up truck for loading the tube installation device in the truck bed ready for transportation to the field. Once the cart is in position behind the tractor the device can be transferred to the tractor (Fig. 3) and the hydraulic system is connected to the standard power-take-off on the tractor. Once the tractor with device is at the field site, a hole for the neutron meter access tube is drilled (Figures 4 and 5). Then the neutron access tube is positioned over the hole (Fig. 6) and thrust into place (Fig. 7) using a special tube cap. All of the drilling and thrusting is done without re-positioning the installation device or moving the tractor. The tube is thrust to a depth which leaves the upper six inches of the tube exposed above the ground. It is then ready for use of the neutron moisture meter for determining soil water content. At the end of the research season, the tube is removed from the ground (Fig. 8).

The installation device has been used to install access tubes in a short time in a manner providing close contact between the access tube and the soil. This operation is essential for proper operation of the neutron moisture meter. The installation device has already been successfully used in the installation tubes in a loam soil, a heavy clay soil, and a soil with a tight, indurated layer (caliche), all to a depth of ten feet.

Submitted Grant Proposals Which Include This Tube Installation Device

E. G. Krenzer, et. al; Sept. 1985; USDA-Cooperative State Research Service.
Epidemiology of Interaction of Selected Pests of Wheat. $73,000

E. G. Krenzer, et. al; Nov. 1985; USDA-Competitive Research Grants Office.
Allelopathic Interactions in Conservation Tillage of Wheat. $220,000

J. F. Stone; Nov. 1985; USDA-Competitive Research Grants Office.
Plant Competition Effects on Water Use Efficiency. $121,000

J. F. Stone; Feb. 1986; USDI-US Geological Survey.
Wide-Spaced Furrow Irrigation to Increase Water Use Efficiency $75,000.

In addition the installation device will be used in soil water measurement in field research in the summer of 1986 on following on-going research projects:

J. F. Stone; OAES Project S-1882.
Patterns of water up-date in wide-spaced furrow irrigation
Jay Ham, graduate student.

E. G. Krenzer; OAES Project S-1837.
Soil and Residue Management vs. Wheat Production
Allan Corr, graduate student.

D. S. Murray; OAES Project S-1873.
Life History, Population Dynamics and Interference of weeds in crops
Eric Castner, graduate student.

D. S. Murray; OAES Project H-933.
Control and Biology of Weeds: Weed-Crop Interactions on Water Use
Mike Riffel, graduate Student.

Publications and Presentations

None. Research applications of this installation device are just starting.

Graduate Student Programs Under Way

Jay Ham, MS candidate

Alan Corr, MS candidate

Eric Castner, MS candidate

Mike Riffel, PhD candidate

Figure 1. Powered tube installation device mounted in transportation position on its transportation cart. Cart is in position for transfer of the device to the tractor.

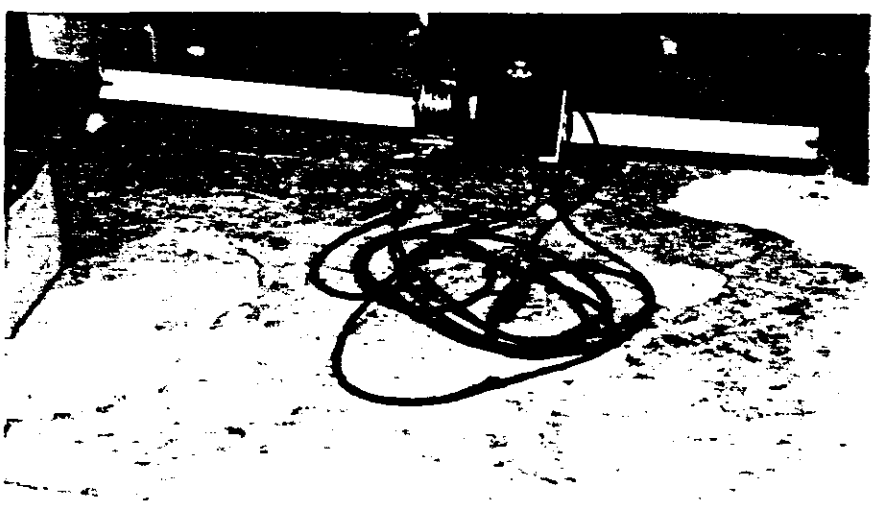

Figure 2. Portable universal winch for loading the transportation cart and device onto the bed of a pick-up truck. The winch will mount to pick-up trucks 1/2 ton or larger. Portable ramps (not shown) are used.

Figure 3. Tube installation device mounted on a standard 3-point hitch on the tractor. The hydraulic pump has been connected to the PTO of the tractor.

Figure 4. Tractor with tube installation device at the field site. The hole to accommodate ten foot access tube is being drilled.

Figure 5. Close-up of auger being removed from the soil.

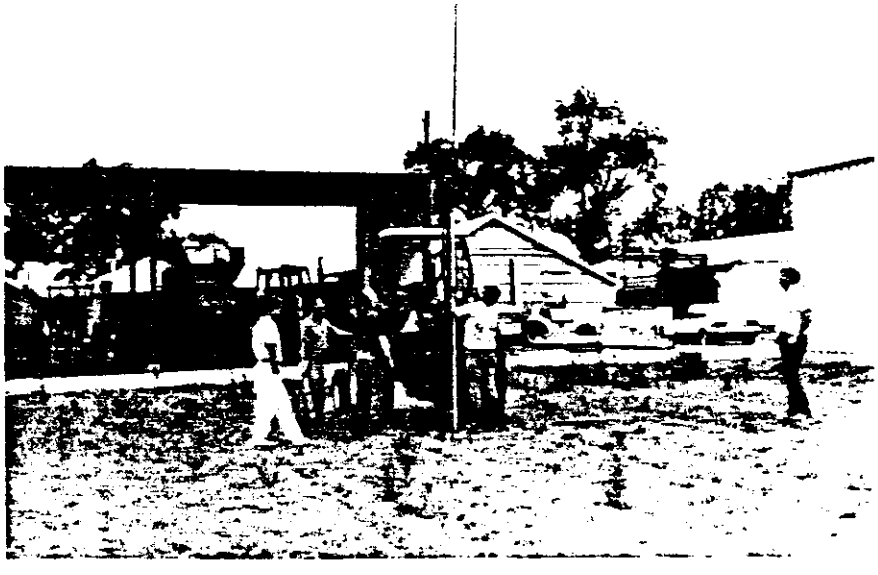

Figure 6. Ten foot joint of access tube being positioned on previously augered hole. Four researchers are being schooled in use of the device.

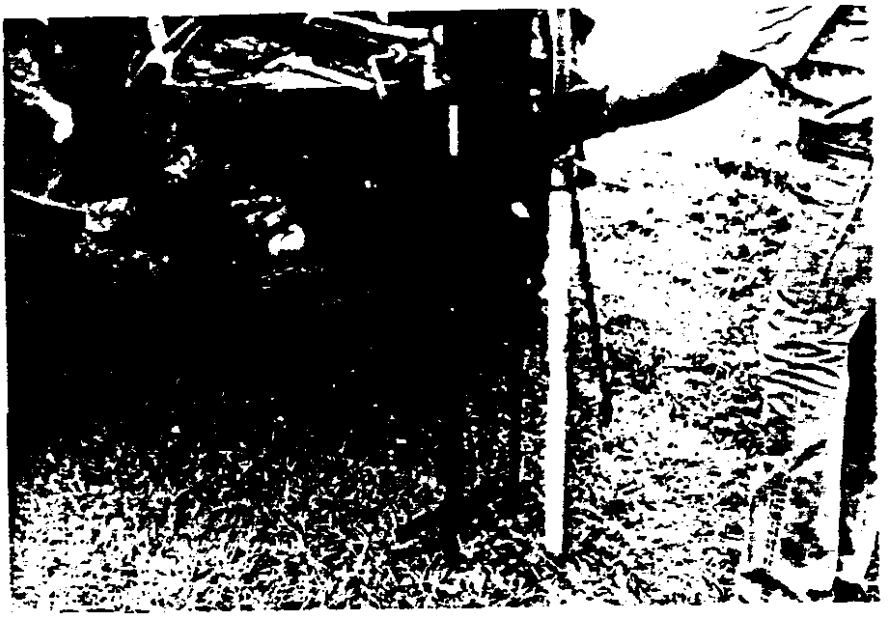

Figure 7. Access tube being readied for final thrust into the soil. Tube will protrude six inches above ground. Special thrusting head is shown just above the tube.

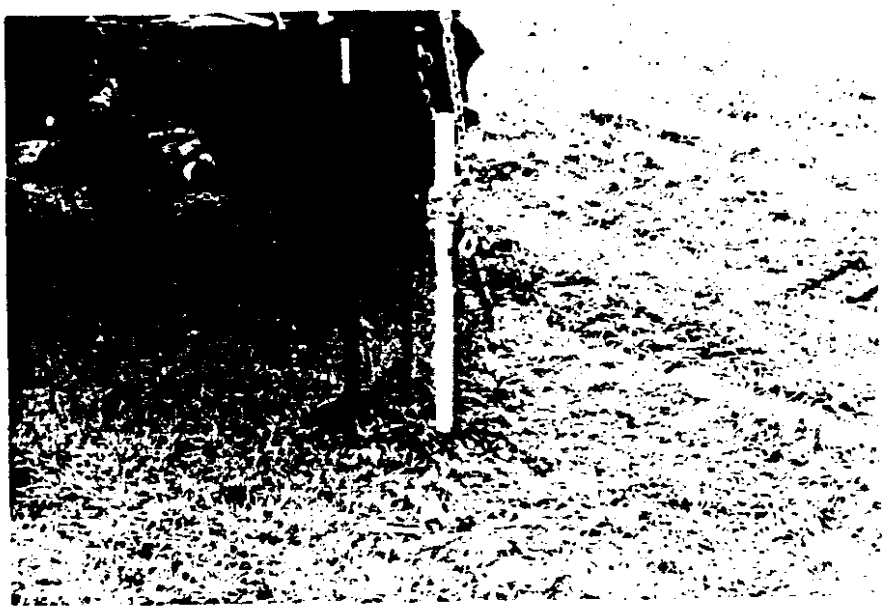

Figure 8. Access tube being pulled from the ground as would be done at the end of the season. Light colored hydraulic pump is visible to the left of the tube.

Specifications

Device to Install Access Tubes

This device will be used to install 10 ft. access tubes for neutron scattering soil moisture meters. The access tubes are thin-wall EMT, nominal 1.5 inch diameter. The device will be tractor-mounted with a standard 3-point hitch (mountings included).

In field operation, the hole will be bored to a depth of 10 feet. Since the coring device will be shorter than 10 feet, all necessary extension equipment to permit coring to 10 feet must be included. Deviation in radial distance of the center line of the completed hole must be no greater than 3/16 inch from a linear ideal center line.

The access tube is started into the hole by hand and attached to an extension bar (included) which is manually attached to the top of the access tube and connected to the thruster on the installation device. Thrust is delivered such that travel of the center line of the access tube is within 3/16 of an inch of the center line of the hole at all points along the tube at all times during installation. If a second thrust is necessary to bring the top of the tube within the reach of the thruster on the device, a second extension bar (included) is used. Thruster is directly connected manually to the access tube for the next thrust. If this thrust leaves the top of the access tube more than 6 inches above the ground then another extension bar (included) will be used for the final thrust.

The process of thrusting must not leave burrs on the top of the access tubes. If the existing thruster does not positively and conveniently couple to the access tube then a special coupler to adapt the thruster to the access tube must be included.

The device when tractor-mounted must be capable of swiveling up to 48 inches between the wheels of the tractor to any desired location along the swing. Adjustment in the direction parallel to the crop rows will be achieved by moving the tractor. Once the location is established it must be possible to bore the hole and install the tube without further movement of the tractor or swivel. Bracing on the device must be sufficient to maintain the specifications of alignment during both the boring of the hole and the thrusting of the access tube.

Purchaser will accept delivery at the factory, but only after the manufacturer has demonstrated to Purchaser's representative satisfactory performance of the device by installing a 10-foot access tube in the field. Purchaser will transport the device to Stillwater, Oklahoma at Purchaser's expense.

Device must conform to standards of the industry regarding design, strengths of materials and assembly. The following equipment will be acceptable in this regard.

Quantity	Model	Item
1	Giddings GSR-T-S	Tractor-mounted sampler with rotary drive and swivel base.
1	Giddings	8' kelly extension bar.
1	Giddings	Extension bar for installing 10' access tubing.
1	Giddings	Wheeled storage cart.

Progress and Completion Report
Oklahoma State University Center for Water Research.
Research Grant: Account No. 1-1-50626
June 13, 1986

Title

Development of powered installation device for neutron access tubes for soil moisture measurement.

Project Leaders

J. F. Stone and M. E. Hodges

Purpose

To acquire a device designed to install soil access tubes for measurement of soil water content by neutron scattering soil moisture meters and the system is to provide measurements to a depth of ten feet.

Several OSU soil water studies have been limited by the depth to which the neutron meters access tubes can be installed manually. Most of these studies have permitted measurements to four feet in the soil. In studies of plants in rainfed conditions we are finding that roots commonly extract water below the four foot depth. There was no powered device on the market to permit installation of access tubes to as deep as ten feet. Thus we proposed to obtain such a device through design or contract.

Procedure

The Giddings Company, Ft. Collins, CO was known to market a device to take soil sample cores to a depth of ten feet or greater. They were contacted shortly after the initiation of the grant in summer of 1985 to see if they felt our project was feasible. They felt it was feasible.

Mr. Hodges went to Ft. Collins in late August of 1985 to develop the design and performance. The Giddings people felt our need could be met by suitable modification of a catalogue listed machine. We then developed a specification sheet (copy appended) and the item went out for bid. We required that the satisfactory performance be demonstrated at the factory and, if successful, we would then accept the device and transport it to Stillwater. The Giddings Machine Company was the only bidder. They developed the design and were ready for inspection and delivery by late April 1986. Mr. Hodges went to Ft. Collins on May 5, 1986 and after some minor modifications the device was deemed to perform according to specifications. We took delivery. On the return trip to Stillwater, Mr. Hodges stopped at the Oklahoma Agricultural Experiment Station research site at Goodwell, Oklahoma and demonstrated that the device would work well in that soil (on which we do many water use studies). This included insertation of tubes through a caliche layer. This layer has previously been a limiting factor in the installation of access tubes. The device functioned satisfactorily. The device was subsequently demonstrated in Stillwater on May 29, 1986. The device is now ready for use in field studies.

Performance of Access Tube Installation Device

The figures show views of the operation of the device at the Stillwater test on May 29, 1986. In Fig. 1 the device is shown mounted on the 3-wheeled transportation cart and is in position to be transferred to tractor for use at the field site. When mounted on the 3-wheeled cart the device can be transported in a pick-up truck to the field site anywhere in the state. A universal electric winch (Fig. 2) can be quickly mounted on any pick-up truck for loading the tube installation device in the truck bed ready for transportation to the field. Once the cart is in position behind the tractor the device can be transferred to the tractor (Fig. 3) and the hydraulic system is connected to the standard power-take-off on the tractor. Once the tractor with device is at the field site, a hole for the neutron meter access tube is drilled (Figures 4 and 5). Then the neutron access tube is positioned over the hole (Fig. 6) and thrust into place (Fig. 7) using a special tube cap. All of the drilling and thrusting is done without re-positioning the installation device or moving the tractor. The tube is thrust to a depth which leaves the upper six inches of the tube exposed above the ground. It is then ready for use of the neutron moisture meter for determining soil water content. At the end of the research season, the tube is removed from the ground (Fig. 8).

The installation device has been used to install access tubes in a short time in a manner providing close contact between the access tube and the soil. This operation is essential for proper operation of the neutron moisture meter. The installation device has already been successfully used in the installation tubes in a loam soil, a heavy clay soil, and a soil with a tight, indurated layer (caliche), all to a depth of ten feet.

Submitted Grant Proposals Which Include This Tube Installation Device

E. G. Krenzer, et. al; Sept. 1985; USDA-Cooperative State Research Service.
Epidemiology of Interaction of Selected Pests of Wheat. $73,000

E. G. Krenzer, et. al; Nov. 1985; USDA-Competitive Research Grants Office.
Allelopathic Interactions in Conservation Tillage of Wheat. $220,000

J. F. Stone; Nov. 1985; USDA-Competitive Research Grants Office.
Plant Competition Effects on Water Use Efficiency. $121,000

J. F. Stone; Feb. 1986; USDI-US Geological Survey.
Wide-Spaced Furrow Irrigation to Increase Water Use Efficiency $75,000.

In addition the installation device will be used in soil water measurement in field research in the summer of 1986 on following on-going research projects:

J. F. Stone; OAES Project S-1882.
Patterns of water up-date in wide-spaced furrow irrigation
Jay Ham, graduate student.

E. G. Krenzer; OAES Project S-1837.
Soil and Residue Management vs. Wheat Production
Allan Corr, graduate student.

D. S. Murray; OAES Project S-1873.
Life History, Population Dynamics and Interference of weeds in crops
Eric Castner, graduate student.

D. S. Murray; OAES Project H-933.
Control and Biology of Weeds: Weed-Crop Interactions on Water Use
Mike Riffel, graduate Student.

Publications and Presentations

None. Research applications of this installation device are just starting.

Graduate Student Programs Under Way

Jay Ham, MS candidate

Alan Corr, MS candidate

Eric Castner, MS candidate

Mike Riffel, PhD candidate

Figure 1. Powered tube installation device mounted in transportation position on its transportation cart. Cart is in position for transfer of the device to the tractor.

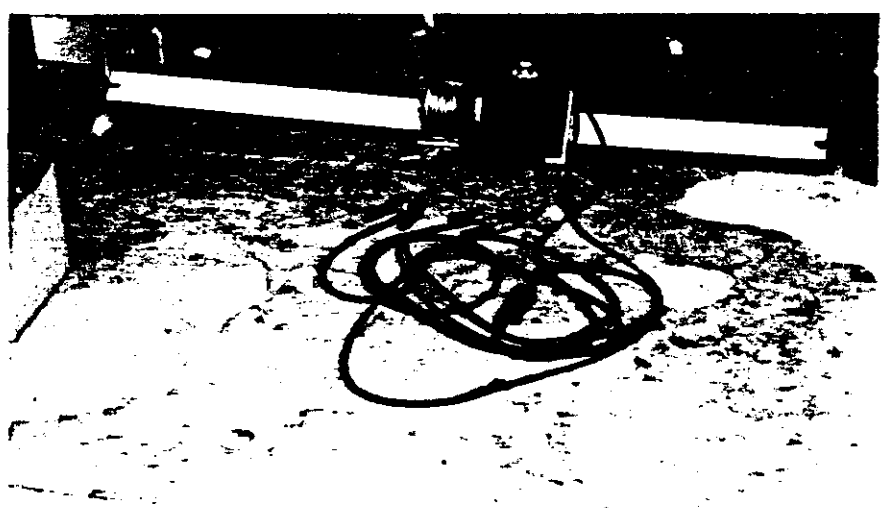

Figure 2. Portable universal winch for loading the transportation cart and device onto the bed of a pick-up truck. The winch will mount to pick-up trucks 1/2 ton or larger. Portable ramps (not shown) are used.

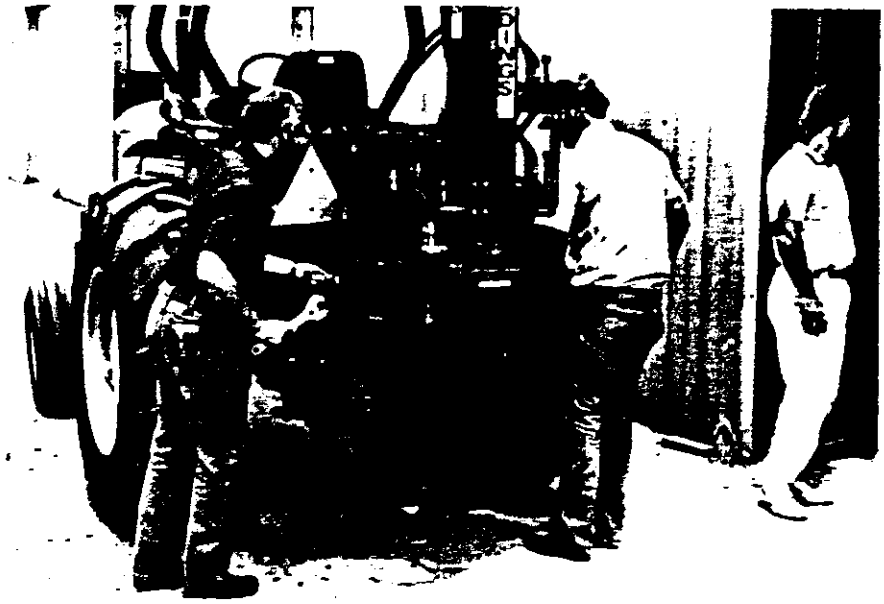

Figure 3. Tube installation device mounted on a standard 3-point hitch on the tractor. The hydraulic pump has been connected to the PTO of the tractor.

Figure 4. Tractor with tube installation device at the field site. The hole to accommodate ten foot access tube is being drilled.

Figure 5. Close-up of auger being removed from the soil.

Figure 6. Ten foot joint of access tube being positioned on previously augered hole. Four researchers are being schooled in use of the device.

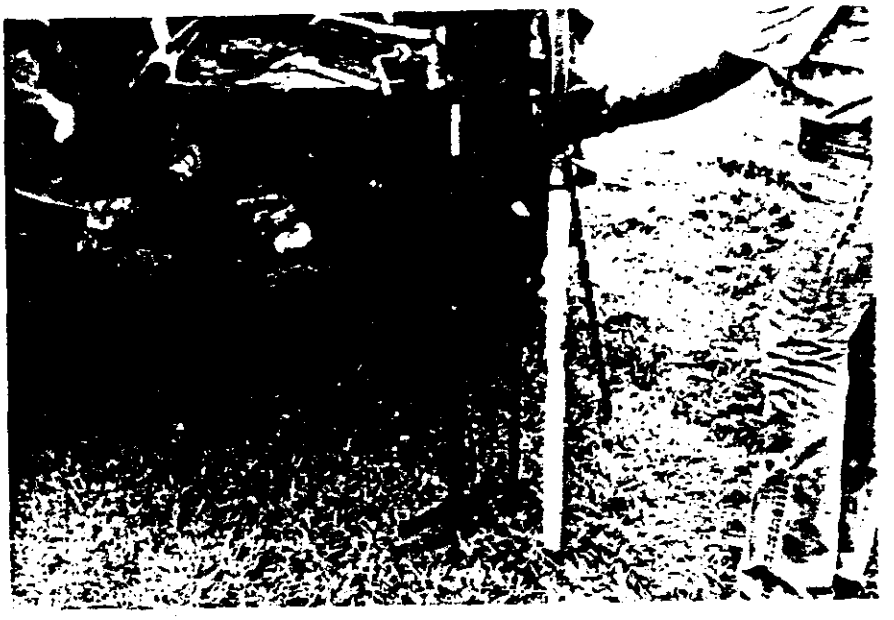

Figure 7. Access tube being readied for final thrust into the soil. Tube will protrude six inches above ground. Special thrusting head is shown just above the tube.

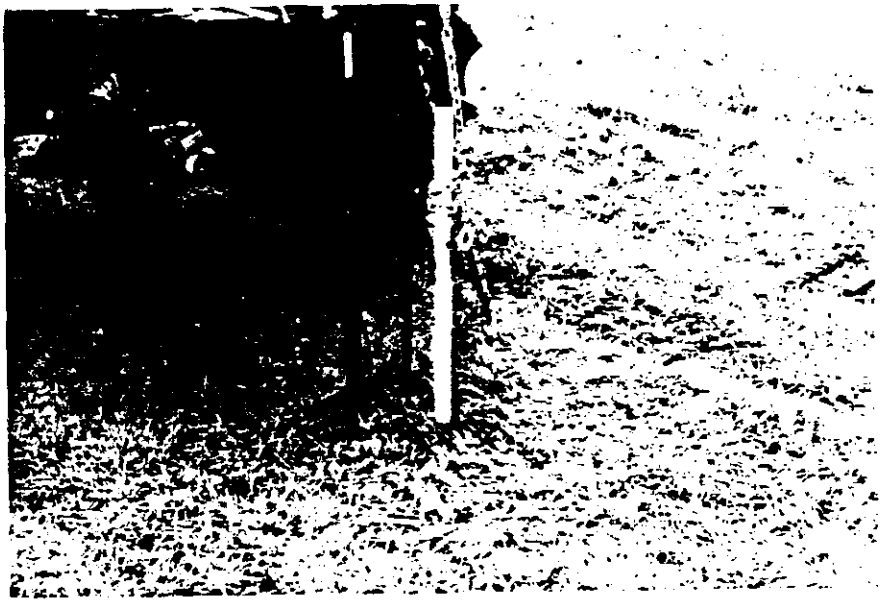

Figure 8. Access tube being pulled from the ground as would be done at the end of the season. Light colored hydraulic pump is visible to the left of the tube.

Specifications

Device to Install Access Tubes

This device will be used to install 10 ft. access tubes for neutron scattering soil moisture meters. The access tubes are thin-wall EMT, nominal 1.5 inch diameter. The device will be tractor-mounted with a standard 3-point hitch (mountings included).

In field operation, the hole will be bored to a depth of 10 feet. Since the coring device will be shorter than 10 feet, all necessary extension equipment to permit coring to 10 feet must be included. Deviation in radial distance of the center line of the completed hole must be no greater than 3/16 inch from a linear ideal center line.

The access tube is started into the hole by hand and attached to an extension bar (included) which is manually attached to the top of the access tube and connected to the thruster on the installation device. Thrust is delivered such that travel of the center line of the access tube is within 3/16 of an inch of the center line of the hole at all points along the tube at all times during installation. If a second thrust is necessary to bring the top of the tube within the reach of the thruster on the device, a second extension bar (included) is used. Thruster is directly connected manually to the access tube for the next thrust. If this thrust leaves the top of the access tube more than 6 inches above the ground then another extension bar (included) will be used for the final thrust.

The process of thrusting must not leave burrs on the top of the access tubes. If the existing thruster does not positively and conveniently couple to the access tube then a special coupler to adapt the thruster to the access tube must be included.

The device when tractor-mounted must be capable of swiveling up to 48 inches between the wheels of the tractor to any desired location along the swing. Adjustment in the direction parallel to the crop rows will be achieved by moving the tractor. Once the location is established it must be possible to bore the hole and install the tube without further movement of the tractor or swivel. Bracing on the device must be sufficient to maintain the specifications of alignment during both the boring of the hole and the thrusting of the access tube.

Purchaser will accept delivery at the factory, but only after the manufacturer has demonstrated to Purchaser's representative satisfactory performance of the device by installing a 10-foot access tube in the field. Purchaser will transport the device to Stillwater, Oklahoma at Purchaser's expense.

Device must conform to standards of the industry regarding design, strengths of materials and assembly. The following equipment will be acceptable in this regard.

Quantity	Model	Item
1	Giddings GSR-T-S	Tractor-mounted sampler with rotary drive and swivel base.
1	Giddings	8' kelly extension bar.
1	Giddings	Extension bar for installing 10' access tubing.
1	Giddings	Wheeled storage cart.