

## **SOIL STRENGTH AS AFFECTED BY DIFFERENT FERTILIZERS UNDER DIFFERENT SOIL COMPACTION AND MOISTURE CONDITIONS**

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A study was undertaken for determining the effect of different levels of different fertilizers (diammonium phosphate i.e. DAP, urea and potassium sulphate) on soil strength or soil penetration resistance under different conditions of compaction and moisture so as to select a fertilizer which reduces soil strength and conserves tractor power. The analysis of the data collected indicated that soil density and moisture affected the penetration resistance or strength of soil more than the fertilizers. It was further established that the strength of soil gradually decreased with DAP and increased with urea and potassium sulphate, suggesting thereby, that DAP is a better fertilizer for conserving tractor power at the time of seedbed preparation.

### **INTRODUCTION**

Fertilizers are generally applied as amendments for the supply of nutrients to plants with a view to increase crop yields. They may have different effects on soil properties. Some of them may increase soil strength, reduce permeability, decrease water holding capacity and increase its ability to stand against external loads while others may reduce soil resistance and increase permeability. Although, soil scientists have studied quite extensively chemical and physical properties of soil resulting from the application of fertilizers, yet a little research work has been carried out to determine the effects of fertilizers on soil strength or penetration resistance of soil. It was, therefore, considered appropriate to conduct investigations for determining the effect of different levels of different fertilizers on the penetration resistance of soil under varying conditions of compaction and moisture. Such a study became all the more im-

portant in view of the increasing trend for fertilizer application. It is quite probable that high doses of some of the fertilizers may increase the strength of soil which may require a high powered tractor in order to prepare a suitable seedbed. This study was accordingly undertaken with the objectives of measuring penetration resistance of soil as affected by different levels of different fertilizers under varying conditions of compaction and moisture and developing suitable mathematical/statistical relationships between them.

### **MATERIALS AND METHODS**

The levels and types of fertilizers, compaction pressure and moisture content considered in these investigations were as follows:

- a. Levels of fertilizers: 200, 400 and 600 lb acre<sup>-1</sup> or 224, 448 and 672 kg ha<sup>-1</sup>.
- b. Types of fertilizers: Diammonium phosphate (DAP), urea and potassium sulphate.

**Table 1.** Effect of different levels of different fertilizers at different soil moisture and a soil density of 1.44 g cm<sup>-3</sup> (90 lb ft<sup>-3</sup>)

Fertilizer		Soil moisture (%)	P = Penetration resistance (N cm <sup>-3</sup> )			Regression equation
Type	Level (kg ha <sup>-1</sup> )		R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	
DAP	224	12	544	545	544	p = 547 - 0.0143 (DAP) (r <sup>2</sup> = 0.98) where DAP = Level of DAP in kg ha <sup>-1</sup>
	448	12	448	541	541	
	672	12	536	536	537	
	224	16	224	223	227	p = 229 - 0.0194 (DAP) (r <sup>2</sup> = 0.922)
	448	16	220	221	222	
	672	16	215	217	215	
	224	20	187	178	179	p = 186 - 0.0273 (DAP) (r <sup>2</sup> = 0.896)
	448	20	173	174	174	
	672	20	165	167	167	
	224	12	546	545	546	p = 542 + 0.0154 U (r <sup>2</sup> = 0.928) where U = Level of urea in kg ha <sup>-1</sup>
	448	12	549	550	547	
	672	12	553	552	553	
Urea (U)	224	16	228	226	229	p = 177 + 0.0254 U (r <sup>2</sup> = 0.915)
	448	16	234	232	230	
	672	16	238	240	240	
	224	20	182	180	185	p = 177 + 0.0256 U (r <sup>2</sup> = 0.863)
	448	20	190	191	188	
	672	20	196	194	191	
	224	12	545	543	544	p = 541 + 0.0148 K (r <sup>2</sup> = 0.834) where K = Level of K in kg ha <sup>-1</sup>
	448	12	547	545	548	
	672	12	549	551	552	
Potassium sulphate (K)	224	16	227	225	224	p = 221 + 0.0234 K (r <sup>2</sup> = 0.908)
	448	16	233	232	230	
	672	16	236	238	234	
	224	20	181	179	183	p = 175 + 0.0278 K (r <sup>2</sup> = 0.901)
	448	20	186	189	190	
	672	20	192	195	194	

Each value of penetration resistance in this table is a mean of 5 observations.

c. Levels of density (compaction): 80, 90 and 100 lb ft<sup>-3</sup> or 1.28, 1.44 and 1.60 g cm<sup>-3</sup>.

d. Levels of moisture: 12, 16 and 20%.

The soil (silty clay loam) collected from the field was dried by spreading over a large plastic sheet in open atmospheric conditions. It was then passed through a sieve of 2 mm openings (No. 10) for removing particles of stone. The required amount of soil was weighed, mixed with a desired amount of water sprayed by a hand sprayer, transferred to the plastic boxes and compacted by a wooden pad for the achievement of desired compaction level. The fertilizer was spread over the soil in the boxes for achieving the desired level and was sealed from the top to avoid loss of moisture. The boxes were opened after 8 days and penetration resistance was measured with a penetrometer (0.25 cm diameter) at 5 cm depth. Five readings of penetration resistance were taken from each box.

## RESULTS AND DISCUSSION

The data obtained were subjected to statistical/mathematical analysis and conclusions were made accordingly. Some of the data and the relevant regression equations for different moisture and for a particular density have been presented in Table 1. The density of soil was varied and the data of penetration resistance were recorded for different levels of different fertilizers and soil moisture.

**Conclusions:** The following conclusions were made after analyzing the entire data with different levels of various fertilizers, moisture and density:

- i. The levels of the fertilizers (DAP, urea and potassium sulphate) affect the penetration resistance of soil significantly.
- ii. The contribution of soil moisture and compaction in affecting the penetration resistance of soil is

much greater than that of the fertilizers.

- iii. The effect of interaction between the levels of individual fertilizers, moisture and density on the penetration resistance of soil is insignificant.
- iv. The regression equations and their graphs (not presented here) suggest that the penetration resistance of soil to a certain extent decreases with the level of DAP and increases with the levels of urea and potassium sulphate.
- v. The regression equations and their graphs further suggest that the effect of the levels of urea and potassium sulphate on the penetration resistance of soil is almost equal.
- vi. The penetration resistance clearly decreases with moisture and increases with density.

The above results suggest that DAP is a better fertilizer in reducing soil resistance and thus conserving tractor power while carrying out seedbed preparations.

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