Research Proposal

Abstract:

This data analysis study will stem from a larger dynamic soil property study currently being done in conjunction with the Natural Resources Conservation Service (NRCS). Where I will observe soil aggregate stability under three tillage practices throughout a series of Hidalgo sandy clay loam soils; Conventional, intermittent and strip tilled agricultural field soils will undergo a wet aggregate laboratory analysis which will ultimately reflect which level of agricultural land management can reproduce a stronger aggregate stability within hidalgo sandy clay loam soils. My Hypothesis is that the soils that have been strip tilled will have a higher soil aggregate stability percentage than soils that have been conventionally or intermittently tilled.

Background:

Currently, agriculture is responsible for the degradation of soils in over 24 million acres of land in the name of global food production (University, 2019). While soil is arguably one of the most valuable resources it is continuously under various methods of anthropogenic land management in order to meet our growing populations demands (Blanco-Canqui & Lal, 2008). When a soil is prepped for cultivation, tillage is often required. However, there are biological indicators within the soil that can reflect repercussions of land management with time. Soil aggregates being one of them that with time become less stable therefor interfering with the lands ability to resist erosion, water and gas movement, infiltration, surface crusting, and soil compaction (*07_AgStab_Fact_Sheet_040517-2id12e5.Pdf*). In a 2015 study from the Food and Agriculture Organization of the United Nations it was noted that in the past 40 years we have already lost a third of our food production soils due to diminished soils (*Home | Food and Agriculture Organization of the United Nations*). All of which is very relevant to a healthy future agriculture system in the Rio Grande Valley.

Methods:

Method	Description
Wet Aggregate Stability: KSSL Method.	Wet Aggregate Stability soil test will measure the if soil aggregates resist falling apart when hit by rain drops or wetted. Unstable aggregates will fall through the sieve and what is left as the stable aggregates will indicate the percentage of stability for that given soil.

Results:

The calculations for this sample group of data are reflective of strip tillage being the most effective land management strategy to implement on agricultural land. Both intermittent and conventional tillage have a significantly lower soil stability percentage mean in comparison to strip tillage who has a mean of 26. We also see that both conventional and strip tillage have a few outliers that increase the overall mean within their respective groups, which lends to a significant impact on the mean for the conventional samples. However, in strip tillage, it has less so of a significant effect. We can also address the soil aggregate sizes and their quantities which can also impact the stability of a soil. In the python analysis we see a plot comparing the sand weight in comparison to the stability percentage and don't see much of a correlation, however given a larger data population analysis we may be able to see a difference.

Soil Stability % Calculations:

(%)={{(WR–SW)/{[IW/(AD/OD)]–Sw}}x100

Aggregate Stability Equation

```
def stabilityperc(WR, Sw, Iw, AD):
    return ((WR- Sw)/((Iw/(AD)) - Sw)) * 100
```

Iw=Initial sample weight (approximately 6g)
WR=Total weight of aggregates retained on sieve throughout process
Sw=Weight of 2- to 0.5-mm sand
AD/OD=Air-dry/oven-dry weight (if not available, use 1.00)

Data: Extracted from Python CSV file.

```
pd.read_excel('Soilaggregate1.xls', index_col=0)   #Adding my other variable in the equation.
```

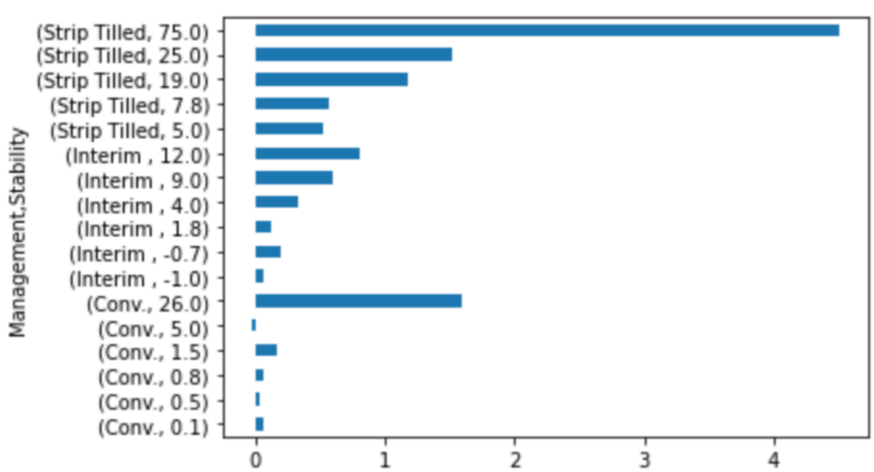
Management	Sample	Iw	Wt1	Wt2	WR	Wt3	Wt4	Sw	AD	Stability
Interim	84	6.00	468.40	468.07	0.33	468.11	468.07	0.04	1	4.0
Interim	85	6.01	187.03	186.22	0.81	186.28	186.22	0.06	1	12.0
Interim	86	6.02	385.77	385.17	0.60	384.67	384.65	0.02	1	9.0
Interim	87	6.01	384.29	384.22	0.07	384.37	384.22	0.15	1	-1.0
Interim	58	6.02	468.50	468.30	0.20	468.54	468.30	0.24	1	-0.7
Interim	59	6.03	186.35	186.23	0.12	186.23	186.22	0.01	1	1.8
Conv.	32	6.00	185.67	185.50	0.17	185.54	185.46	0.08	1	1.5
Conv.	24	6.02	384.20	384.22	-0.02	384.32	384.65	-0.37	1	5.0
Conv.	1	6.02	195.50	185.44	0.06	185.45	185.40	0.05	1	0.1
Conv.	6	6.01	187.07	185.48	1.59	185.48	185.48	0.00	1	26.0
Conv.	10	6.02	185.49	185.45	0.04	185.48	185.47	0.01	1	0.5
Conv.	2	6.00	185.47	185.40	0.07	185.47	185.45	0.02	1	0.8
Strip Tilled	135	6.02	186.75	186.23	0.52	186.45	186.23	0.22	1	5.0
Strip Tilled	154	6.00	187.41	186.23	1.18	186.25	186.23	0.02	1	19.0
Strip Tilled	155	6.00	468.87	468.30	0.57	468.41	468.30	0.11	1	7.8
Strip Tilled	141	6.00	187.00	185.48	1.52	185.49	185.48	0.01	1	25.0
Strip Tilled	143	6.00	190.72	186.22	4.50	186.23	186.22	0.01	1	75.0

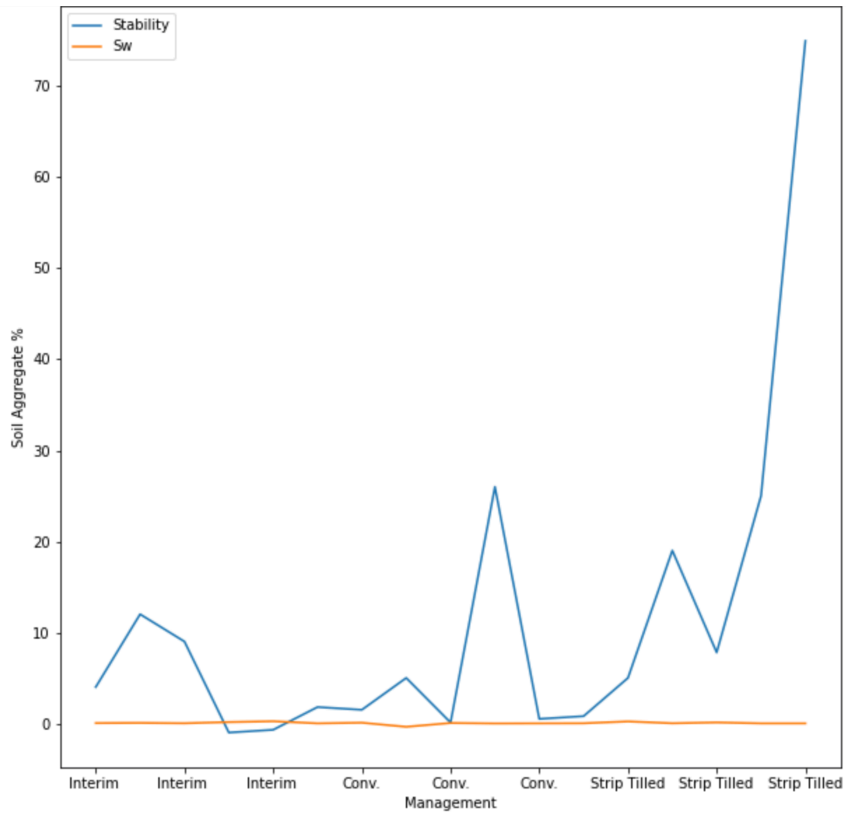
Tillage Strategies Under Analysis
Conservation/strip tillage: minimizes the use of constant soil disruption and only tills on the portion of the soil that will be seeded.
Intermittent tillage: Tillage done throughout the growing season as needed but less frequently that conventional tillage.
Conventional tillage: Most common within agriculture- constant disturbance of the soil in an effort to control weeds and produce fine soil ready for planting.

Python Analysis:

```
soil.groupby(['Management','Stability']).WR.sum().plot(kind='barh')
```

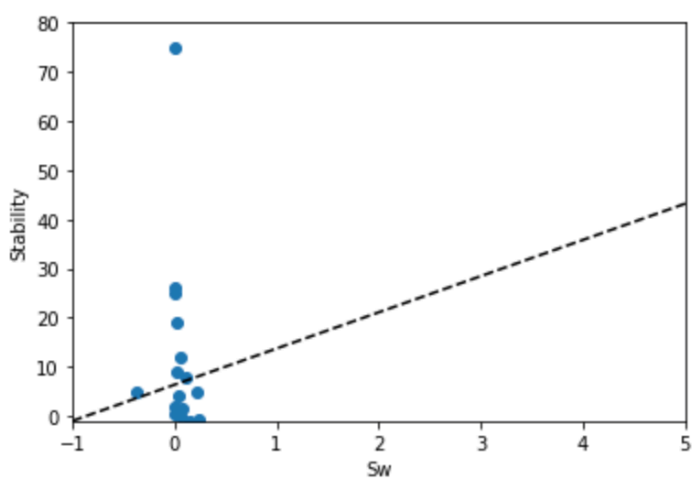
```
<AxesSubplot:ylabel='Management,Stability'>
```






```
plt.scatter(soil['Sw'], soil['Stability'])
plt.plot([-1,10],[-1,80], 'k--')
plt.xlabel('Sw')
plt.ylabel('Stability')
plt.xlim([-1,5])
plt.ylim([-1,80])    #CORRELATION?
```

```
(-1.0, 80.0)
```



Discussion:

As far as we can analyze from this small data population, utilizing strip tillage on agricultural land will equate to having a larger aggregate stability while opting for conventional or intermittent tillage would have the opposite effect. Under strip tillage farmers can increase the structure of the land, aid in decreasing land degradation through environmental weatherization and works towards a healthier soil long term. With the term soil health now used to popularize not only the capacity of a soils agricultural output but also the environmental sustainability (Steven et al) it behooves us to reduce tillage, also known to increase the macro aggregate population; which can have compounding positive effects on the stability percentage of a given soil (Fuentes et al). Given the data visualization, I believe this study can have a stronger statistical foundation by increasing the population size of the soil samples being tested for soil stability percentage while also assessing the potential negative impacts of strip tillage as well (Monneveux et al).

Sources:

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4. *07_AgStab_Fact_Sheet_040517-2id12e5.Pdf*. https://cpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/f/5772/files/2016/12/07_AgStab_Fact_Sheet_040517-2id12e5.pdf. Accessed 3 Apr. 2021.
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6. Stevens, Andrew W. "Economic Theory Provides Insights for Soil Health Policy." *Choices*, vol. 34, no. 2, 2019, pp. 1–6, https://www.jstor.org/stable/26785775.
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