

## Supplementary Materials

```
pd.options.mode.chained_assignment = None
df = pd.read_excel('../Field data.xlsx', sheet_name='Grain legume crop')
df_ur = pd.read_excel('../Yields.xlsx', sheet_name='Grain legume crop')
```

Figure S1: Calculating the average temperature.

```
sum_column = (df['Max. deg. C'] + df['Min. deg. C'])/2
df['Average C'] = sum_column
float_data = df[['NDVI', 'Average deg. C', 'Surface ground humidity (%)', 'Root zone humidity (%)', 'Wind speed (m/s)', 'Humidity (%)', 'Precipitation (mm)', 'Date']].copy(deep=True)
df_NDVI = float_data[float_data['NDVI'] != '-' & (float_data['Surface Moisture (%)'] != '-')]
df_NDVI['Moisture of topsoil (%)'] = df_NDVI['Moisture of topsoil (%)'].astype('float64')
df_NDVI['moisture in the root zone (%)'] = df_NDVI['moisture in the root zone (%)'].astype('float64')
df_NDVI['NDVI'] = df_NDVI['NDVI'].astype('float64')
df_NDVI.info()
```

Figure S2: Sorting and cleaning the database.

```
x = df_NDVI['NDVI']
y = df_NDVI.drop(['Root zone humidity (%)', 'Humidity (%)', 'Precipitation (mm)', 'Date', 'NDVI'], axis=1)
X_train, X_test, y_train, y_test = train_test_split(y, x, test_size=0.1, random_state=10)
```

Figure S3: Dividing the database into a training database and a test database.

```
def predict(model):
    model.fit(X_train, y_train)
    y_pred = model.predict(X_test)
    mse = mean_squared_error(y_test, y_pred)
    rmse = mean_squared_error(y_test, y_pred, squared=False)
    pred_y_df=pd.DataFrame({'Actual':y_test, 'Predicted':y_pred, 'Diff': y_test-y_pred}).reset_index(drop=True)
    pred_y_df.loc[pred_y_df['Diff'] < 0, 'Diff'] = pred_y_df['Diff'] * -1
    print(pred_y_df)
    print('mse =', mse)
    print('rmse =', rmse)
```

Figure S4: code snippet of predict() function.

```
df1 = df[(df['Date'] > '2017-04-01') & (df['Date'] < '2017-07-01')]
df2 = df[(df['Date'] > '2018-04-01') & (df['Date'] < '2018-07-01')]
df3 = df[(df['Date'] > '2019-04-01') & (df['Date'] < '2019-07-01')]
df4 = df[(df['Date'] > '2020-04-01') & (df['Date'] < '2020-07-01')]
df5 = df[(df['Date'] > '2021-04-01') & (df['Date'] < '2021-07-01')]
df6 = df[(df['Date'] > '2022-04-01') & (df['Date'] < '2022-07-01')]
df = pd.concat([df1, df2, df3, df4, df5, df6])
```

Figure S5. Creating a Pandas database with yields.

Table S1: Results of yield predictions.

<b>Culture</b>	<b>Activation functions</b>	<b>Output for the entire growing season</b>	<b>Output for the sowing and harvesting period</b>
Grain legume crop	LinearRegression	Prediction - 15.5938294 Actual value- 13 Accuracy – 80.05% MSE – 6.72795094257164 RMSE - 2.5938293973528097	Prediction - -14.22348 Actual value- 13 Accuracy – 90,69% MSE – 741.1178862516509 RMSE - 27.223480421350445
	Ridge regression	Prediction - 9.76738 Actual value- 13 Accuracy – 75.14% MSE – 10.44983519437905 RMSE - 3.2326204841241495	Prediction - 9.909979 Actual value- 13 Accuracy – 76.24% MSE – 9.548229598906833 RMSE - 3.090020970625739
	Dummy Regressor	Prediction - 9.75 Actual value- 13 Accuracy – 75% MSE – 10.5625 RMSE – 3.25	Prediction - 9.75 Actual value- 13 Accuracy – 75% MSE – 10.5625 RMSE – 3.25

<b>Culture</b>	<b>Activation functions</b>	<b>Output for the entire growing season</b>	<b>Output for the sowing and harvesting period</b>
	Support Vector Regression	Prediction - 10.06618338 Actual value- 13 Accuracy – 77.43% MSE – 8.607279934754404 RMSE – 2.9338166157335746	Prediction - 10.626944 Actual value- 13 Accuracy – 81.75% MSE – 5.631392475571471 RMSE – 2.3730555146417185
	Multi-layer Perceptron	Prediction - 11.98386956 Actual value- 13 Accuracy – 92.2% MSE – 1.0325210703580439 RMSE – 1.0161304396375712	Prediction - 14.210564 Actual value- 13 Accuracy – 90.69% MSE – 1.4654656756540216 RMSE – 1.21056419724607
	Polynomial regression	Prediction - 13.27294033 Actual value- 13 Accuracy – 97.1% MSE – 0.07449642166540053 RMSE – 0.2729403261986043	Prediction - 5.072371 Actual value- 13 Accuracy – 39.02% MSE – 62.84730925222773 RMSE – 7.9276294850495965

<b>Culture</b>	<b>Activation functions</b>	<b>Output for the entire growing season</b>	<b>Output for the sowing and harvesting period</b>
	RandomForest	Prediction - 10.56 Actual value- 13 Accuracy – 81.24% MSE – 5.953599999999998 RMSE – 2.439999999999995	Prediction - 10.44 Actual value- 13 Accuracy – 80.31% MSE – 6.553600000000003 RMSE – 2.5600000000000005
Oilseed crop	LinearRegression	Prediction - 1.520977 Actual value- 12 Accuracy – 12.68% MSE – 109.8099127645022 RMSE - 10.479022509972111	Prediction - 16.348741 Actual value- 12 Accuracy – 63.77% MSE – 18.91154813203163 RMSE - 4.348740982403026
	Ridge regression	Prediction - 9.742192 Actual value- 12 Accuracy – 81.19% MSE – 5.097697268824957 RMSE - 2.2578080673132863	Prediction - 9.652679 Actual value- 12 Accuracy – 80.44% MSE – 5.509914232524477 RMSE - 2.3473206497035033
	Dummy Regressor	Prediction - 9.75 Actual value- 12 Accuracy – 81.25% MSE – 5.0625 RMSE – 2.25	Prediction - 9.75 Actual value- 12 Accuracy – 81.25% MSE – 5.0625 RMSE – 2.25

<b>Culture</b>	<b>Activation functions</b>	<b>Output for the entire growing season</b>	<b>Output for the sowing and harvesting period</b>
	Support Vector Regression	Prediction - 9.521013 Actual value- 13 Accuracy – 79.35% MSE – 6.14537575213908 RMSE – 2.4789868398479005	Prediction - 9.223484 Actual value- 12 Accuracy – 76.87% MSE – 7.70904144022213 RMSE – 2.7765160615818907
	Multi-layer Perceptron	Prediction - 11.908672 Actual value- 12 Accuracy – 99.24% MSE – 0.008340833505743486 RMSE – 0.09132816381458397	Prediction - 11.662348 Actual value- 12 Accuracy – 97.19% MSE – 0.11400863071989471 RMSE – 0.33765164107389545
	Polynomial regression	Prediction - 8.163432 Actual value- 12 Accuracy – 68.03% MSE – 14.719252202183062 RMSE – 3.8365677632726705	Prediction - 12.612762 Actual value- 12 Accuracy – 94.9% MSE – 0.37547682708455027 RMSE – 0.6127616396973217

<b>Culture</b>	<b>Activation functions</b>	<b>Output for the entire growing season</b>	<b>Output for the sowing and harvesting period</b>
	RandomForest	Prediction - 9.72 Actual value- 12 Accuracy – 81% MSE – 5.198399999999997 RMSE – 2.2799999999999994	Prediction - 9.32 Actual value- 12 Accuracy – 87.67% MSE – 7.182399999999999 RMSE – 2.6799999999999997
Feed crop	LinearRegression	Prediction - 10.953747 Actual value- 11 Accuracy – 99.58% MSE – 0.002139336554443382 RMSE - 0.04625296265584922	Prediction - 20.642508 Actual value- 11 Accuracy – 12.35% MSE – 92.97795891221809 RMSE - 9.642507916108656
	Ridge regression	Prediction - 13.521812 Actual value- 11 Accuracy – 77.08% MSE – 6.359537081122683 RMSE - 2.521812261276141	Prediction - 13.448367 Actual value- 11 Accuracy – 77.75% MSE – 5.994503265610556 RMSE - 2.4483674694805426
	Dummy Regressor	Prediction - 13.5 Actual value- 11 Accuracy – 78.28% MSE – 6.25 RMSE – 2.5	Prediction - 13.5 Actual value- 11 Accuracy – 78.28% MSE – 6.25 RMSE – 2.5

<b>Culture</b>	<b>Activation functions</b>	<b>Output for the entire growing season</b>	<b>Output for the sowing and harvesting period</b>
	Support Vector Regression	Prediction - 13.572706 Actual value- 11 Accuracy – 76.62% MSE – 6.618817691836597 RMSE – 2.572706297235772	Prediction - 13.531542 Actual value- 11 Accuracy – 76.99% MSE – 6.408702453498788 RMSE – 2.531541517237825
	Multi-layer Perceptron	Prediction - 14.767129 Actual value- 11 Accuracy – 65.76% MSE – 14.191262648073945 RMSE – 3.767129231666196	Prediction - 17.247889 Actual value- 11 Accuracy – 43.21% MSE – 39.03611787495848 RMSE – 6.247889073515829
	Polynomial regression	Prediction - 10.84963 Actual value- 11 Accuracy – 98.64% MSE – 0.022611029170841374 RMSE – 0.15036964178597145	Prediction - 12.363653 Actual value- 11 Accuracy – 87.6% MSE – 1.8595503529438493 RMSE – 1.3636533111256135

<b>Culture</b>	<b>Activation functions</b>	<b>Output for the entire growing season</b>	<b>Output for the sowing and harvesting period</b>
	RandomForest	Prediction - 13.8 Actual value- 11 Accuracy – 74.55% MSE – 7.8400000000000004 RMSE – 2.8000000000000007	Prediction - 12.81 Actual value- 11 Accuracy – 83.55% MSE – 3.2761000000000002 RMSE – 1.8100000000000005
Cereal crop	LinearRegression	Prediction - 15.117106 Actual value- 11 Accuracy – 62.58% MSE – 16.950565499966554 RMSE - 4.117106447490343	Prediction - 12.084224 Actual value- 11 Accuracy – 80.15% MSE – 1.1755407184616784 RMSE - 1.08422355557407
	Ridge regression	Prediction - 13.773203 Actual value- 11 Accuracy – 74.79% MSE – 7.690655543695103 RMSE - 2.773203119804805	Prediction - 13.688406 Actual value- 11 Accuracy – 75.56% MSE – 7.227527653053278 RMSE - 2.6884061547789386
	Dummy Regressor	Prediction - 13.75 Actual value- 11 Accuracy – 75% MSE – 7.5625 RMSE – 2.75	Prediction - 13.75 Actual value- 11 Accuracy – 75% MSE – 7.5625 RMSE – 2.75



<b>Culture</b>	<b>Activation functions</b>	<b>Output for the entire growing season</b>	<b>Output for the sowing and harvesting period</b>
	Support Vector Regression	Prediction - 13.531542 Actual value- 11 Accuracy – 76.09% MSE – 6.408702453498788 RMSE – 2.531541517237825	Prediction - 13.875316 Actual value- 11 Accuracy – 73.87% MSE – 8.267444720784995 RMSE – 2.875316455763608
	Multi-layer Perceptron	Prediction - 12.774175 Actual value- 11 Accuracy – 83.88% MSE – 3.1476964349157988 RMSE – 1.7741748602986682	Prediction - 13.007714 Actual value- 11 Accuracy – 82.75% MSE – 4.030916501289399 RMSE – 2.007714247917118
	Polynomial regression	Prediction - 15.006737 Actual value- 11 Accuracy – 63.6% MSE – 16.053942018825378 RMSE – 4.006737078824287	Prediction - 13.939934 Actual value- 11 Accuracy – 75.28% MSE – 8.643211310139888 RMSE – 2.9399338955391308

<b>Culture</b>	<b>Activation functions</b>	<b>Output for the entire growing season</b>	<b>Output for the sowing and harvesting period</b>
	RandomForest	Prediction - 13.8 Actual value- 11 Accuracy – 72.1% MSE – 9.424900000000001 RMSE – 3.0700000000000003	Prediction - 13.5 Actual value- 11 Accuracy – 78.28% MSE – 6.25 RMSE – 2.5