Hand Calculating Degree Days

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Introduction

Development of many organisms is dependent on temperature. All farmers know that crops and pests develop faster in warmer than in cooler years. However, there is not necessarily a yield or quality benefit in cool or warm seasons. Organisms simply grow or develop faster when the air temperature is warmer.

When temperatures are higher, organisms develop faster. However, they are exposed to the greater heat for fewer days and the net accumulation of heat required for development is about the same as for organisms grown under cooler conditions for more days. This accumulation of heat is called "physiological time" and ^{o}D are a measure of physiological time. **One ^{o}D is defined as one degree above a threshold temperature (T_L) during 24 hours.**

Regardless of the temperature range for growth, the number of ^{o}D to develop is about the same, whereas the number of days to develop is greatly different. Clearly, ^{o}D provides a better predictive tool for development. Even with fluctuating temperature, it is the total heat accumulation within an optimal range that determines the time to complete development.

Hand Calculating Degree Days

When a threshold temperature is below the minimum temperature, the degree-days are simply calculated as the mean minus the threshold temperature. If the threshold

is above the maximum temperature, then there are zero degree-days. However, the calculation is more complicated for the single sine wave method, which is used in California, when the threshold falls between the minimum and maximum temperatures.

The calculation of ^{o}D with microcomputers is relatively simple, but not everyone uses computers. As an alternative, Snyder (1998) presented a method to calculate ^{o}D using the table given below for the case when the threshold temperature falls between the daily maximum and minimum temperature. The results are the same as using the single sine method (Zalom et al., 1983). To use the table, simply calculate the daily temperature amplitude (α):

$$\alpha = \frac{T_{max} - T_{min}}{2}$$

and the ratio (R):

$$R = \frac{T_L - T_{min}}{T_{max} - T_{min}}$$

Find the value for N corresponding to R in the table and multiply N by the temperature amplitude (α) to calculate ^{o}D. Again, when the threshold is lower than the minimum temperature, ºD are calculated as the difference between the mean and threshold temperatures.

Degree-day hand calculation table. Calculate a value for R and select the corresponding N value from the table. Multiply N by the daily temperature amplitude α

R	**N**	**R**	**N**	**R**	**N**
0.00	1.00	0.34	0.495	0.67	0.167
0.01	0.981	0.35	0.483	0.68	0.159
0.02	0.962	0.36	0.471	0.69	0.152
0.03	0.944	0.37	0.459	0.70	0.144
0.04	0.927	0.38	0.448	0.71	0.137
0.05	0.910	0.39	0.436	0.72	0.130
0.06	0.893	0.40	0.425	0.73	0.123
0.07	0.876	0.41	0.413	0.74	0.116
0.08	0.859	0.42	0.402	0.75	0.109

0.09	0.843	0.43	0.391	0.76	0.102
0.10	0.827	0.44	0.381	0.77	0.096
0.11	0.811	0.45	0.370	0.78	0.090
0.12	0.796	0.46	0.359	0.79	0.084
0.13	0.780	0.47	0.349	0.80	0.078
0.14	0.765	0.48	0.339	0.81	0.072
0.15	0.750	0.49	0.328	0.82	0.066
0.16	0.735	0.50	0.318	0.83	0.061
0.17	0.721	0.51	0.308	0.84	0.055
0.18	0.706	0.52	0.299	0.85	0.050
0.19	0.692	0.53	0.289	0.86	0.045
0.20	0.678	0.54	0.279	0.87	0.040
0.21	0.664	0.55	0.27	0.88	0.036
0.22	0.650	0.56	0.261	0.89	0.031
0.23	0.636	0.57	0.251	0.90	0.027
0.24	0.622	0.58	0.242	0.91	0.023
0.25	0.609	0.59	0.233	0.92	0.019
0.26	0.596	0.60	0.225	0.93	0.016
0.27	0.583	0.61	0.216	0.94	0.013
0.28	0.570	0.62	0.208	0.95	0.010
0.29	0.557	0.63	0.199	0.96	0.007
0.30	0.554	0.64	0.191	0.97	0.004
0.31	0.532	065	0.183	0.98	0.002
0.32	0.519	0.66	0.175	0.99	0.001
0.33	0.507			1.00	0.000

References

Snyder, R.L. 1985. Hand calculating degree-days. J. Agric. & For. Meteorol. 35:353-358.

Zalom, F.G., P.B. Goodell, L.T. Wilson, W.W. Barnett, and W.J. Bentley. 1983. Degree-days: The calculation and use of heat units in pest management. UC DANR Leaflet 21373.