

## BehavePlus Tips, Tricks, and Information

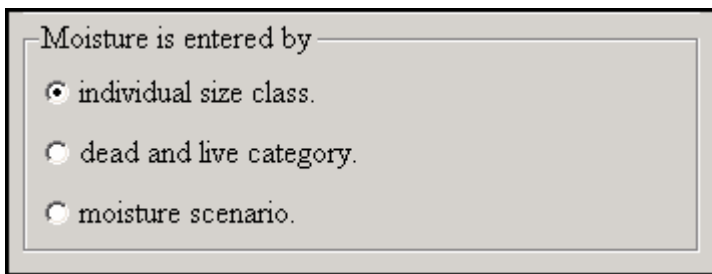
### Topic:

Dead fuel moisture = 1-h = 10-h = 100-h compared to 10-h = 1-h +1%, 100-h = 1-h +2% (Bonus: How to use BehavePlus to do the analysis. Moisture scenarios. Export to html.)

**Date:** July 14, 2007

**Prepared by:** Pat Andrews

The BehavePlus fire modeling system offers three options for defining the moisture content for surface fuel components.



When moisture is entered by *individual size class* is selected, a moisture value is entered for each size class: 1-h, 10-h, 100-h, live woody, and live herbaceous fuel.

When moisture is entered by *dead and live category* is selected, the dead fuel moisture value is then used for 1-h, 10-h and 100-h fuel moisture and the live fuel moisture value is used for live woody and live herbaceous moisture.

When moisture is entered by *moisture scenario*, a set of five moisture values can be defined, saved, and specified by name.

The question is whether to add the option of specifying a 1-h moisture value and automatically assigning  $10-h = 1-h +1\%$  and  $100-h = 1-h + 2\%$ .

That is the process that is taught in NWCG fire behavior courses. This approximation was suggested by Rothermel (1983, p.14).

It is easy to directly enter moisture values into BehavePlus using that relationship for a single run. For tables and graphs, labeling would be confusing and awkward. But most importantly, there is essentially no difference between the +1% and +2% option and using the same value for all fuel size classes.

BehavePlus includes intermediate values to facilitate understanding of the modeling. Characteristic dead fuel moisture is the value that is calculated from the weighting factors based on the loading of each size class and the moisture content of each size class.

The following table shows the characteristic dead fuel moisture for the 53 standard fuel models for 1-h moisture from 2 to 30 in steps of 2 and the associated 10-h = 1-h +1% and 100-h = 1-h +2%. There is only one case where there is a difference between the 1-h moisture and the characteristic dead fuel moisture: fuel model TL7—Large Downed Logs. There is effectively no benefit to using the +1% and +2% relationships over using the same value for all dead fuel size classes.

This does not mean that the moisture content of 10-h and 100-h fuels doesn't matter. Attached are two tables that show characteristic dead fuel moisture for ranges of 1-h and 10-h fuel moisture. The effect of 10-h and 100-h moisture depends on how much different they are from 1-h moisture and on the distribution of fuel in the fuel model.

**Bottom line:** If you don't have moisture values for each size class, just use the same value for all of them. Use the option 'Moisture is entered by dead and live category.'

Characteristic Dead Fuel Moisture (live moisture = 100%)

Fuel Model	Dead fuel moisture, 1-h, 10-h = 1-h + 1%, 100-h = 1-h + 2%														
	02-03-04	04-05-06	06-07-08	08-09-10	10-11-12	12-13-14	14-15-16	16-17-18	18-19-20	20-21-22	22-23-24	24-25-26	26-27-28	28-29-30	30-31-32
1	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
2	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
3	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
4	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
5	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
6	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
7	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
8	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
9	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
10	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
11	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
12	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
13	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
gr1	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
gr2	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
gr3	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
gr4	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
gr5	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
gr6	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
gr7	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
gr8	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
gr9	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
gs1	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
gs2	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
gs3	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
gs4	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30

Fuel Model	Dead fuel moisture, 1-h, 10-h = 1-h + 1%, 100-h = 1-h + 2%														
	02-03-04	04-05-06	06-07-08	08-09-10	10-11-12	12-13-14	14-15-16	16-17-18	18-19-20	20-21-22	22-23-24	24-25-26	26-27-28	28-29-30	30-31-32
sh1	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
sh2	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
sh3	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
sh4	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
sh5	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
sh6	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
sh7	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
sh8	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
sh9	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
tu1	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
tu2	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
tu3	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
tu4	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
tu5	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
tl1	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
tl2	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
tl3	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
tl4	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
tl5	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
tl6	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
tl7	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31
tl8	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
tl9	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
sb1	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
sb2	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
sb3	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
sb4	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30

The yellow highlights show where the characteristic dead fuel moisture is not the same as the 1-h moisture. Fuel model 12 has relatively more 10-h and 100-h fuel than does fuel model 2.

**Characteristic Dead Fuel Moisture (%)**

Fuel Model 2. 100-h fuel moisture = 5%, Live fuel moisture = 75%

1-h Moisture %	10-h Moisture %														
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
28	27	28	28	28	28	28	28	28	28	28	28	28	28	28	28
30	29	29	30	30	30	30	30	30	30	30	30	30	30	30	30

**Characteristic Dead Fuel Moisture (%)**

Fuel Model 12. 100-h fuel moisture = 5%, Live fuel moisture = 75%

1-h Moisture %	10-h Moisture %														
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
2	2	3	3	3	4	4	4	5	5	6	6	6	7	7	8
4	4	4	4	5	5	6	6	6	7	7	7	8	8	9	9
6	5	6	6	6	7	7	7	8	8	9	9	9	10	10	11
8	7	7	7	8	8	9	9	9	10	10	10	11	11	12	12
10	8	9	9	9	10	10	10	11	11	12	12	12	13	13	13
12	10	10	10	11	11	12	12	12	13	13	13	14	14	15	15
14	11	12	12	12	13	13	13	14	14	15	15	15	16	16	16
16	13	13	13	14	14	15	15	15	16	16	16	17	17	18	18
18	14	15	15	15	16	16	16	17	17	18	18	18	19	19	19
20	16	16	16	17	17	18	18	18	19	19	19	20	20	21	21
22	17	18	18	18	19	19	19	20	20	21	21	21	22	22	22
24	19	19	19	20	20	21	21	21	22	22	22	23	23	24	24
26	20	21	21	21	22	22	22	23	23	24	24	24	25	25	25
28	22	22	22	23	23	24	24	24	25	25	25	26	26	27	27
30	23	24	24	24	25	25	25	26	26	27	27	27	28	28	28

Suggestion: Try similar runs with 100-h fuel moisture = 10%.

Something to think about: Can live fuel moisture affect characteristic dead fuel moisture?

**Bonus:**

How I used BehavePlus to do this analysis...

I built and saved 15 moisture scenarios for each of the combinations of 1-h, 10-h, and 100-h fuel moisture. I selected all of the fuel models and all of my new moisture scenarios to build the table. The Moisture scenario names and descriptions are listed at the end of the run along with the fuel model names.

BehavePlus 4.0.0 Sat, Jul 14, 2007 at 12:58:51 Page 1

**Inputs: SURFACE**  
Description → Examine effect of 10h=1h+1% and 100h=1h+2%

**Fuel/Vegetation, Surface/Understory**  
Fuel Model → 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, gr1,

**Fuel Moisture**  
Moisture Scenario → 02-03-04, 04-05-06, 06-07-08, 08-09-10, 10-11-12

**Run Option Notes**  
None

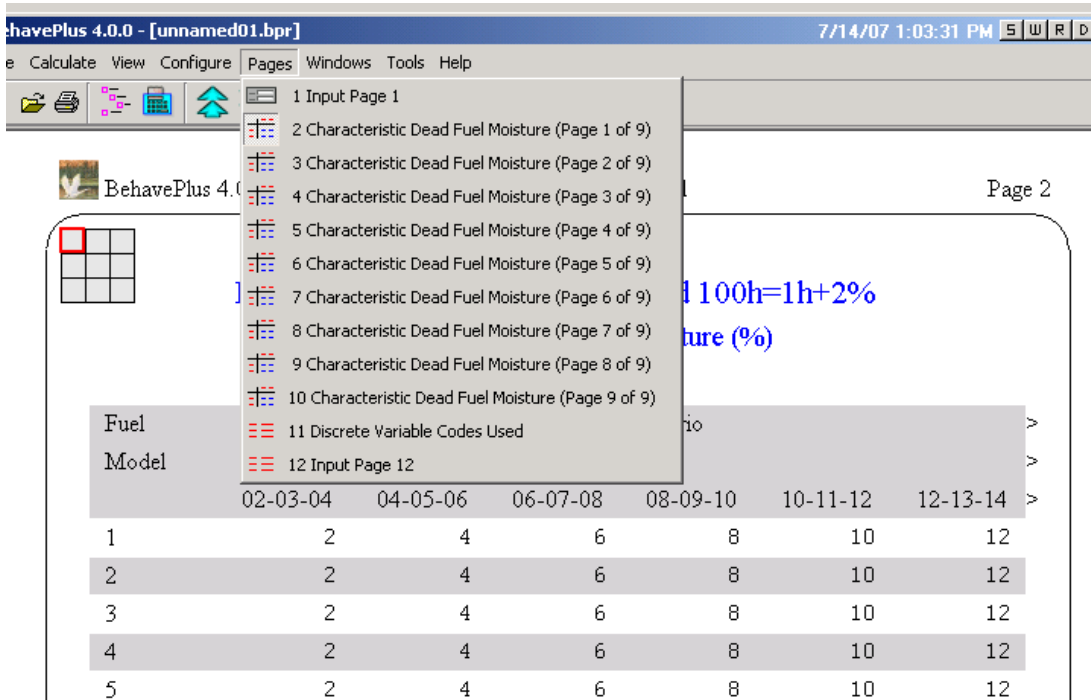
**Output Variables**  
Characteristic Dead Fuel Moisture (%) [SURFACE]

BehavePlus 4.0.0 Sat, Jul 14, 2007 at 12:58:51 Page 12

Input Worksheet (continued)

Moisture Scenario	Description
02-03-04	1-h = 2%, 10-h=3%, 100-h=4%
04-05-06	1-h = 4
06-07-08	1-h = 6
08-09-10	1-h = 8
10-11-12	1-h = 10
12-13-14	1-h = 12
14-15-16	1-h = 14
16-17-18	1-h = 16
18-19-20	1-h = 18
20-21-22	1-h = 20
22-23-24	1-h = 22
24-25-26	1-h = 24
26-27-28	1-h = 26
28-29-30	1-h = 28
30-31-32	1-h = 30

The resulting table is 53+ rows and 15+ columns and is on 9 BehavePlus output pages.



I saved the results in html format, which puts all of the values into a single table. I opened the file with Excel, added highlights, and adjusted spacing and headings. I inserted the tables into a Word document to produce this report.

To see the moisture values for a moisture scenario, right click on the selected scenario in the Input Guide window and select 'View Parameters'.

