Here I basically carry out the MINITAB17 statistical software to analysis this data.

The researcher has used light intensity (as treatment with 3 different levels: 5W, 10W, 15W) for measure germination potential how they are significantly differing.

He has measured different responses. Such as,

Seedling length (Root and Shoot separately)

Germination percentage (with dark control group)

1. **The effect of 4 type of light intensity on seeding length (Total length with shoot & root)**

|  |  |  |  |
| --- | --- | --- | --- |
| Replication | 5W | 10W | 15W |
| 1 | 7.86 | 6.06 | 4.535 |
| 2 | 7.83 | 6.065 | 4.215 |
| 3 | 7.86 | 5.875 | 4.67 |
| 4 | 7.655 | 6.305 | 4.94 |

MINITAB output:

Analysis of Variance (ANOVA)

Source DF Adj SS Adj MS F-Value P-Value

Factor 2 20.6623 10.3311 235.46 0.000

Error 9 0.3949 0.0439

Total 11 21.0571

Hypothesis

* Null hypothesis (H0) :- There is same effect of 3 type of light intensity on seeding length.
* Alternative hypothesis (H1) :-The effects on seeding of light intensities are not all the same. (At least on pair of light intensities are different)

Conclusions

Since p value (0.000) is less than the significance value (0.005), we can reject the null hypothesis. That is different type of light intensities significantly differ on seeding length.

Therefore, at 5% significance level (even at 1%), we have sufficient evidence to say that 3 types of light intensities have significant effect on seeding length.

Mean comparisons

Tukey Pairwise Comparisons

Tukey Simultaneous Tests for Differences of Means

Difference Difference SE of Adjusted

of Levels of Means Difference 95% CI T-Value P-Value

10W - 5W -1.725 0.148 (-2.139, -1.311) -11.65 0.000

15W - 5W -3.211 0.148 (-3.625, -2.798) -21.68 0.000

15W - 10W -1.486 0.148 (-1.900, -1.073) -10.03 0.000

In here all p values of different comparisons are less than the significant value. So that is in hypothetically,

H0 :-

H1  :- for some i & j, ( : mean of each treatment)

Since all p values (0.000) are less than the significance value (0.05), we can reject the null hypothesis.

Therefore, at 5% significance level, we have sufficient evidence to say that all light intensities have significantly different effect on seeding length.

Grouping Information Using the Tukey Method and 95% Confidence

Factor N Mean Grouping

5W 4 7.8013 A

10W 4 6.0762 B

15W 4 4.590 C

Means that do not share a letter are significantly different.

So any treatment group doesn’t have shared letter. That means all light intensities have significantly different effect on seeding length.

1. **The effect of 4 type of light intensity on germination percentage (with dark control treatment group)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Replications | 5W | 10W | 15W | DARK (Control) |
| 1 | 90 | 88 | 100 | 58 |
| 2 | 90 | 90 | 100 | 58 |
| 3 | 94 | 88 | 100 | 56 |
| 4 | 90 | 88 | 98 | 50 |

MINITAB output:

Analysis of Variance (ANOVA)

Source DF Adj SS Adj MS F-Value P-Value

Factor 3 4484.75 1494.92 294.08 0.000

Error 12 61.00 5.08

Total 15 4545.75

Hypothesis

* Null hypothesis (H0) :- There is same effect of 4 type of light intensity on germination.
* Alternative hypothesis (H1) :-The effects on germination of light intensities are not all the same. (At least on pair of light intensities are different)

Conclusions

Since p value (0.000) is less than the significance value (0.05), we can reject the null hypothesis. That is different type of light intensities significantly differ on germination.

Therefore, at 5% significance level (even at 1%), we have sufficient evidence to say that 4 types of light intensities have significant effect on germination.

Mean comparisons

Dunnett Multiple Comparisons with a Control

Dunnett Simultaneous Tests for Level Mean - Control Mean

Difference SE of Adjusted

Difference of Levels of Means Difference 95% CI T-Value P-Value

5W - DARK (Contro 35.50 1.59 (31.22, 39.78) 22.27 0.000

10W - DARK (Contro 33.00 1.59 (28.72, 37.28) 20.70 0.000

15W - DARK (Contro 44.00 1.59 (39.72, 48.28) 27.60 0.000

In here all p values of different comparisons with control group are less than the significant value. So that is in hypothetically,

H0 :-

H1  :- for some i, ( : mean of each treatment)

Since all p values (0.000) are less than the significance value (0.05), we can reject the null hypothesis.

Therefore, at 5% significance level, we have sufficient evidence to say that all light intensities have significantly different effect with control group on germination.

Grouping Information Using the Dunnett Method and 95% Confidence

Factor N Mean Grouping

DARK (Control) (control) 4 55.50 A

15W 4 99.500

5W 4 91.00

10W 4 88.500

Means not labeled with the letter A are significantly different from the control level mean.

So any treatment group doesn’t have the letter (A). That means all light intensities have significantly different effect with control group on germination.