An initial varietal trial (Late Sown, irrigated) was conducted to study the performance of 18 new stra ins of using a Randomized complete Block Design (RCB) design at Bhatinda with 3 replications. The s eed yield in kg/ha was recorded. The details of the experiment are given below:

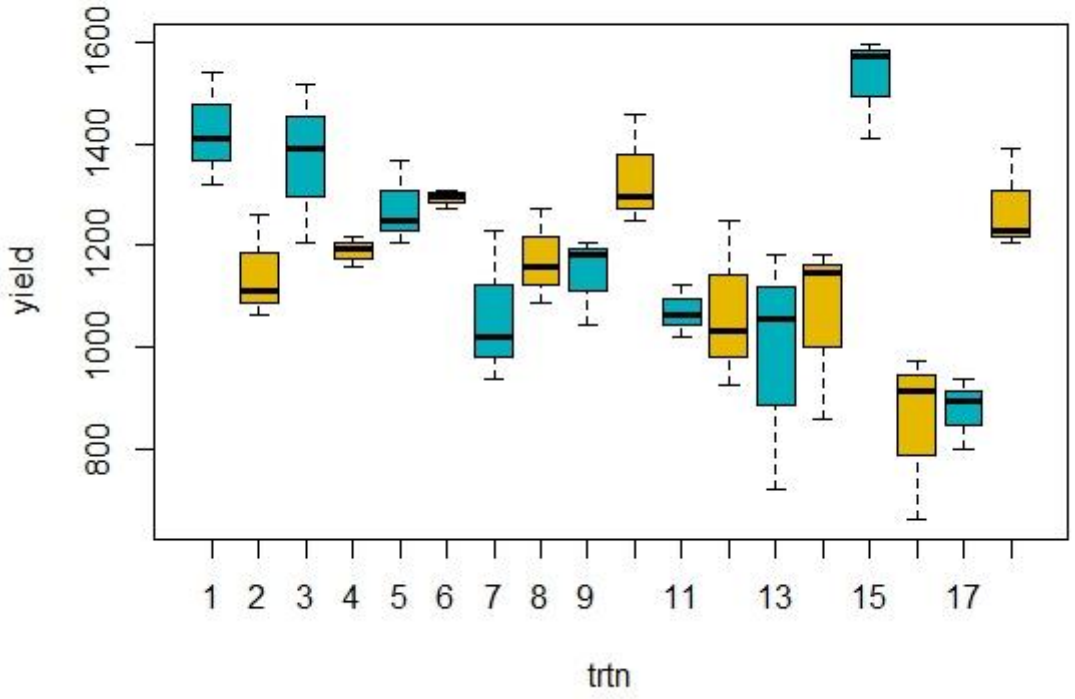
sino	trtn	B1	B2	B3
1	RK-04-3	1539.69	1412.35	1319.73
2	RK-04-4	1261.85	1065.05	1111.36
3	RGN-124	1389.19	1516.54	1203.97
4	HYT-27	1192.39	1215.55	1157.66
5	PBR-275	1250.27	1203.97	1366.04
6	HUJM-03-03	1296.58	1273.43	1308.16
7	RGN-123	1227.12	1018.74	937.71
8	BIO-13-01	1273.43	1157.66	1088.2
9	RH-0115	1180.82	1203.97	1041.9
10	RH-0213	1296.58	1458.65	1250.27
11	NRCDR-05	1122.93	1065.05	1018.74
12	NRC-323-1	1250.27	926.13	1030.32
13	RRN-596	1180.82	1053.47	717.75
14	RRN-597	1146.09	1180.82	856.67
15	CS-234-2	1574.42	1412.35	1597.57
16	RM-109	914.55	972.44	659.87
17	BAUSM-2000	891.4	937.71	798.79
18	NPJ-99	1227.12	1203.97	1389.19

```
data<-read.table(file="clipboard",header = TRUE)
> str(data)
'data.frame':   54 obs. of  3 variables:
 $ trtn : int  1 2 3 4 5 6 7 8 9 10 ...
 $ blk  : int  1 1 1 1 1 1 1 1 1 1 ...
 $ yield: num  1540 1262 1389 1192 1250 ...

trtn and blk are grouping variable so convert into factor format

> data$trtn<-as.factor(data$trtn)
> data$blk<-as.factor(data$blk)
> str(data)
'data.frame':   54 obs. of  3 variables:
 $ trtn : Factor w/ 18 levels "1","2","3","4",..: 1 2 3 4 5 6 7 8 9 10 ...
 $ blk  : Factor w/ 3 levels "1","2","3": 1 1 1 1 1 1 1 1 1 1 ...
 $ yield: num  1540 1262 1389 1192 1250 ...
> names(data)
[1] "trtn"  "blk"   "yield"
> boxplot(yield~trtn, data = data, xlab = "trtn", ylab = "yield",
```

```
+          col = c("#00AFBB", "#E7B800"))
```




```
> m1<-aov(yield~trtn+blk,data=data)
> summary(m1)
            Df  Sum Sq Mean Sq F value   Pr(>F)
trtn        17 1698530   99914   8.501 8.01e-08 ***
blk          2  157113   78557   6.684  0.00356 **
Residuals   34  399597   11753
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Both blocks and treatments Prob. Values are less than 0.05 so blocks and treatments are significantly different. Go for post hoc test for treatment s

```
> lm1<-lm(yield~trtn+blk,data=data)
> library(lsmeans)
> lsm1<-lsmeans(lm1,"trtn")
> pairs(lsm1)
 contrast  estimate   SE df t.ratio p.value
 1 - 2     277.8367 88.5 34   3.139  0.1966
 1 - 3      54.0233 88.5 34   0.610  1.0000
 1 - 4     235.3900 88.5 34   2.659  0.4420
 1 - 5     150.4967 88.5 34   1.700  0.9535
```

1 - 6	131.2000	88.5	34	1.482	0.9864
1 - 7	362.7333	88.5	34	4.098	0.0219
1 - 8	250.8267	88.5	34	2.834	0.3389
1 - 9	281.6933	88.5	34	3.182	0.1806
1 - 10	88.7567	88.5	34	1.003	0.9998
1 - 11	355.0167	88.5	34	4.011	0.0274
1 - 12	355.0167	88.5	34	4.011	0.0274
1 - 13	439.9100	88.5	34	4.970	0.0021
1 - 14	362.7300	88.5	34	4.098	0.0219
1 - 15	-104.1900	88.5	34	-1.177	0.9989
1 - 16	574.9700	88.5	34	6.496	<.0001
1 - 17	547.9567	88.5	34	6.190	0.0001
1 - 18	150.4967	88.5	34	1.700	0.9535
2 - 3	-223.8133	88.5	34	-2.528	0.5265
2 - 4	-42.4467	88.5	34	-0.480	1.0000
2 - 5	-127.3400	88.5	34	-1.439	0.9898
2 - 6	-146.6367	88.5	34	-1.657	0.9626
2 - 7	84.8967	88.5	34	0.959	0.9999
2 - 8	-27.0100	88.5	34	-0.305	1.0000
2 - 9	3.8567	88.5	34	0.044	1.0000
2 - 10	-189.0800	88.5	34	-2.136	0.7782
2 - 11	77.1800	88.5	34	0.872	1.0000
2 - 12	77.1800	88.5	34	0.872	1.0000
2 - 13	162.0733	88.5	34	1.831	0.9174
2 - 14	84.8933	88.5	34	0.959	0.9999
2 - 15	-382.0267	88.5	34	-4.316	0.0124
2 - 16	297.1333	88.5	34	3.357	0.1263
2 - 17	270.1200	88.5	34	3.052	0.2319
2 - 18	-127.3400	88.5	34	-1.439	0.9898
3 - 4	181.3667	88.5	34	2.049	0.8253
3 - 5	96.4733	88.5	34	1.090	0.9996
3 - 6	77.1767	88.5	34	0.872	1.0000
3 - 7	308.7100	88.5	34	3.488	0.0951
3 - 8	196.8033	88.5	34	2.223	0.7263
3 - 9	227.6700	88.5	34	2.572	0.4979
3 - 10	34.7333	88.5	34	0.392	1.0000
3 - 11	300.9933	88.5	34	3.400	0.1151
3 - 12	300.9933	88.5	34	3.400	0.1151
3 - 13	385.8867	88.5	34	4.359	0.0111
3 - 14	308.7067	88.5	34	3.488	0.0951
3 - 15	-158.2133	88.5	34	-1.787	0.9310
3 - 16	520.9467	88.5	34	5.885	0.0002
3 - 17	493.9333	88.5	34	5.580	0.0004
3 - 18	96.4733	88.5	34	1.090	0.9996

4 - 5	-84.8933	88.5	34	-0.959	0.9999
4 - 6	-104.1900	88.5	34	-1.177	0.9989
4 - 7	127.3433	88.5	34	1.439	0.9898
4 - 8	15.4367	88.5	34	0.174	1.0000
4 - 9	46.3033	88.5	34	0.523	1.0000
4 - 10	-146.6333	88.5	34	-1.657	0.9626
4 - 11	119.6267	88.5	34	1.351	0.9947
4 - 12	119.6267	88.5	34	1.351	0.9947
4 - 13	204.5200	88.5	34	2.311	0.6710
4 - 14	127.3400	88.5	34	1.439	0.9898
4 - 15	-339.5800	88.5	34	-3.836	0.0422
4 - 16	339.5800	88.5	34	3.836	0.0422
4 - 17	312.5667	88.5	34	3.531	0.0863
4 - 18	-84.8933	88.5	34	-0.959	0.9999
5 - 6	-19.2967	88.5	34	-0.218	1.0000
5 - 7	212.2367	88.5	34	2.398	0.6136
5 - 8	100.3300	88.5	34	1.133	0.9993
5 - 9	131.1967	88.5	34	1.482	0.9864
5 - 10	-61.7400	88.5	34	-0.697	1.0000
5 - 11	204.5200	88.5	34	2.311	0.6710
5 - 12	204.5200	88.5	34	2.311	0.6710
5 - 13	289.4133	88.5	34	3.270	0.1515
5 - 14	212.2333	88.5	34	2.398	0.6137
5 - 15	-254.6867	88.5	34	-2.877	0.3154
5 - 16	424.4733	88.5	34	4.795	0.0034
5 - 17	397.4600	88.5	34	4.490	0.0078
5 - 18	0.0000	88.5	34	0.000	1.0000
6 - 7	231.5333	88.5	34	2.616	0.4696
6 - 8	119.6267	88.5	34	1.351	0.9947
6 - 9	150.4933	88.5	34	1.700	0.9535
6 - 10	-42.4433	88.5	34	-0.479	1.0000
6 - 11	223.8167	88.5	34	2.529	0.5265
6 - 12	223.8167	88.5	34	2.529	0.5265
6 - 13	308.7100	88.5	34	3.488	0.0951
6 - 14	231.5300	88.5	34	2.616	0.4697
6 - 15	-235.3900	88.5	34	-2.659	0.4420
6 - 16	443.7700	88.5	34	5.013	0.0018
6 - 17	416.7567	88.5	34	4.708	0.0043
6 - 18	19.2967	88.5	34	0.218	1.0000
7 - 8	-111.9067	88.5	34	-1.264	0.9974
7 - 9	-81.0400	88.5	34	-0.916	1.0000
7 - 10	-273.9767	88.5	34	-3.095	0.2137
7 - 11	-7.7167	88.5	34	-0.087	1.0000
7 - 12	-7.7167	88.5	34	-0.087	1.0000

7 - 13	77.1767	88.5	34	0.872	1.0000
7 - 14	-0.0033	88.5	34	0.000	1.0000
7 - 15	-466.9233	88.5	34	-5.275	0.0009
7 - 16	212.2367	88.5	34	2.398	0.6136
7 - 17	185.2233	88.5	34	2.093	0.8024
7 - 18	-212.2367	88.5	34	-2.398	0.6136
8 - 9	30.8667	88.5	34	0.349	1.0000
8 - 10	-162.0700	88.5	34	-1.831	0.9174
8 - 11	104.1900	88.5	34	1.177	0.9989
8 - 12	104.1900	88.5	34	1.177	0.9989
8 - 13	189.0833	88.5	34	2.136	0.7782
8 - 14	111.9033	88.5	34	1.264	0.9974
8 - 15	-355.0167	88.5	34	-4.011	0.0274
8 - 16	324.1433	88.5	34	3.662	0.0640
8 - 17	297.1300	88.5	34	3.357	0.1263
8 - 18	-100.3300	88.5	34	-1.133	0.9993
9 - 10	-192.9367	88.5	34	-2.180	0.7528
9 - 11	73.3233	88.5	34	0.828	1.0000
9 - 12	73.3233	88.5	34	0.828	1.0000
9 - 13	158.2167	88.5	34	1.787	0.9310
9 - 14	81.0367	88.5	34	0.915	1.0000
9 - 15	-385.8833	88.5	34	-4.359	0.0111
9 - 16	293.2767	88.5	34	3.313	0.1384
9 - 17	266.2633	88.5	34	3.008	0.2511
9 - 18	-131.1967	88.5	34	-1.482	0.9864
10 - 11	266.2600	88.5	34	3.008	0.2512
10 - 12	266.2600	88.5	34	3.008	0.2512
10 - 13	351.1533	88.5	34	3.967	0.0306
10 - 14	273.9733	88.5	34	3.095	0.2137
10 - 15	-192.9467	88.5	34	-2.180	0.7527
10 - 16	486.2133	88.5	34	5.493	0.0005
10 - 17	459.2000	88.5	34	5.188	0.0011
10 - 18	61.7400	88.5	34	0.697	1.0000
11 - 12	0.0000	88.5	34	0.000	1.0000
11 - 13	84.8933	88.5	34	0.959	0.9999
11 - 14	7.7133	88.5	34	0.087	1.0000
11 - 15	-459.2067	88.5	34	-5.188	0.0011
11 - 16	219.9533	88.5	34	2.485	0.5555
11 - 17	192.9400	88.5	34	2.180	0.7528
11 - 18	-204.5200	88.5	34	-2.311	0.6710
12 - 13	84.8933	88.5	34	0.959	0.9999
12 - 14	7.7133	88.5	34	0.087	1.0000
12 - 15	-459.2067	88.5	34	-5.188	0.0011
12 - 16	219.9533	88.5	34	2.485	0.5555

```
 12 - 17   192.9400 88.5 34  2.180  0.7528
 12 - 18  -204.5200 88.5 34 -2.311  0.6710
 13 - 14   -77.1800 88.5 34 -0.872  1.0000
 13 - 15  -544.1000 88.5 34 -6.147  0.0001
 13 - 16   135.0600 88.5 34  1.526  0.9820
 13 - 17   108.0467 88.5 34  1.221  0.9983
 13 - 18  -289.4133 88.5 34 -3.270  0.1515
 14 - 15  -466.9200 88.5 34 -5.275  0.0009
 14 - 16   212.2400 88.5 34  2.398  0.6136
 14 - 17   185.2267 88.5 34  2.093  0.8024
 14 - 18  -212.2333 88.5 34 -2.398  0.6137
 15 - 16   679.1600 88.5 34  7.673  <.0001
 15 - 17   652.1467 88.5 34  7.367  <.0001
 15 - 18   254.6867 88.5 34  2.877  0.3154
 16 - 17   -27.0133 88.5 34 -0.305  1.0000
 16 - 18  -424.4733 88.5 34 -4.795  0.0034
 17 - 18  -397.4600 88.5 34 -4.490  0.0078

Results are averaged over the levels of: blk
P value adjustment: tukey method for comparing a family of 18 estimates
> library(multcompView)
Warning message:
package ‘multcompView’ was built under R version 3.4.4
> CLD(lsm1,Letters = "abcdefghijklm")
 trtn lsmean   SE df lower.CL upper.CL .group
 16      849 62.6 34      722      976  a
 17      876 62.6 34      749     1003  ab
 13      984 62.6 34      857     1111  abc
 7      1061 62.6 34      934     1188  abcd
 14     1061 62.6 34      934     1188  abcd
 12     1069 62.6 34      942     1196  abcd
 11     1069 62.6 34      942     1196  abcd
 9      1142 62.6 34     1015     1269  abcde
 2      1146 62.6 34     1019     1273  abcde
 8      1173 62.6 34     1046     1300  abcde
 4      1189 62.6 34     1061     1316   bcde
 18     1273 62.6 34     1146     1401    cdef
 5      1273 62.6 34     1146     1401    cdef
 6      1293 62.6 34     1166     1420    cdef
 10     1335 62.6 34     1208     1462     def
 3      1370 62.6 34     1243     1497     def
 1      1424 62.6 34     1297     1551      ef
 15     1528 62.6 34     1401     1655       f
```

```
Results are averaged over the levels of: blk
Confidence level used: 0.95
P value adjustment: tukey method for comparing a family of 18 estimates
Significance level used: alpha = 0.05
```

Conclusion: even though treatment 15 have highest average yield (1528), it is on par with 1st, 3rd, 10th, 6th , 5th and 18th treatment. So we can choose among this (15, 1, 3, 10, 6, 5 and 18) as treatment for future use.