

APPENDICES

Appendix 3.01: Analysis of variance table for *Aspergillus flavus* infestation in mungbean

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	2.57143	0.85714	0.56	0.6467
Variety (Var)	6	2877.71	479.619	314.75	0.0000
Interaction (Rep*Var)	18	27.4286	1.52381		
Total	27	2907.71			

Appendix 3.02: Analysis of variance table for *Aspergillus niger* infestation in mungbean

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	7.00000	2.33333	1.05	0.3946
Variety (Var)	6	4482.86	747.143	336.21	0.0000
Interaction (Rep*Var)	18	40.0000	2.22222		
Total	27	4529.86			

Appendix 3.03: Analysis of variance table for *Aspergillus terreus* infestation in mungbean.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	0.67857	0.22619	0.31	0.8168
Variety (Var)	6	389.214	64.8690	89.33	0.0000
Interaction (Rep*Var)	18	13.0714	0.72619		
Total	27	402.964			

Appendix 3.04: Analysis of variance table for *Alternaria sp.* infestation in mungbean.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	1.25000	0.41667	0.54	0.6637
Variety (Var)	6	845.429	140.905	181.16	0.0000
Interaction (Rep*Var)	18	14.0000	0.77778		
Total	27	860.679			

Appendix 3.05: Analysis of variance table for *Cladosporium sp.* infestation in mungbean

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	1.25000	0.41667	0.83	0.4929
Variety (Var)	6	650.714	108.452	216.90	0.0000
Interaction (Rep*Var)	18	9.00000	0.50000		
Total	27	660.964			

Appendix 3.06: Analysis of variance table for *Curvularia sp.* infestation in mungbean.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	1.25000	0.41667	1.00	0.4155
Variety (Var)	6	35.3571	5.89286	14.14	0.0000
Interaction (Rep*Var)	18	7.50000	0.41667		
Total	27	44.1071			

Appendix 3.07: Analysis of variance table for *Fusarium sp.* infestation in mungbean.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	3.82143	1.27381	1.77	0.1882
Variety (Var)	6	539.929	89.9881	125.29	0.0000
Interaction (Rep*Var)	18	12.9286	0.71825		
Total	27	556.679			

Appendix 3.08: Analysis of variance table for *Macrophomina phaseolina* infestation in mungbean.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	2.42857	0.80952	1.16	0.3526
Variety (Var)	6	2134.86	355.810	509.45	0.0000
Interaction (Rep*Var)	18	12.5714	0.69841		
Total	27	2149.86			

Appendix 3.09: Analysis of variance table for *Penicillium sp.* infestation in mungbean

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	3.82143	1.27381	2.20	0.1234
Variety (Var)	6	1034.43	172.405	297.58	0.0000
Interaction (Rep*Var)	18	10.4286	0.57937		
Total	27	1048.68			

Appendix 3.10: Analysis of variance table for *Colletotrichum sp.* infestation in mungbean.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	0.14286	0.04762	1.00	0.4155
Variety (Var)	6	69.4286	11.5714	243.00	0.0000
Interaction (Rep*Var)	18	0.85714	0.04762		
Total	27	70.4286			

Appendix 3.11: Analysis of variance table for *Drechslera sp.* infestation in mungbean

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	0.28571	0.09524	1.41	0.2719
Variety (Var)	6	1.92857	0.32143	4.76	0.0045
Interaction (Rep*Var)	18	1.21429	0.06746		
Total	27	3.42857			

Appendix 3.12: Analysis of variance table for *Rhizopus sp.* infestation in mungbean

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	0.71429	0.23810	0.44	0.7286
Variety (Var)	6	139.357	23.2262	42.72	0.0000
Interaction (Rep*Var)	18	9.78571	0.54365		
Total	27	149.857			

Appendix 3.13: Analysis of variance table for *Myrothecium sp.* infestation in mungbean.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	3.522E-	1.174E-33	1.00	0.4155
Variety (Var)	6	333.42857	0.57143	M	M
Interaction (Rep*Var)	18	2.113E-32	1.174E-33		
Total	27	3.42857			

Appendix 3.14: Analysis of variance table for Germination of seed (%) after fungal infestation in mungbean.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	22.4286	7.47619	2.86	0.0658
Variety (Var)	6	3968.93	661.488	252.95	0.0000
Interaction (Rep*Var)	18	47.0714	2.61508		
Total	27	4038.43			

Appendix 3.15: Analysis of variance table for *Aspergillus flavus* infestation in blackgram

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	0.50000	0.16667	0.50	0.7082
Variety (Var)	1	8.00000	8.00000	24.00	0.0163
Interaction (Rep*Var)	3	1.00000	0.33333		
Total	7	9.50000			

Appendix 3.16: Analysis of variance table for *Aspergillus niger* infestation in blackgram

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	0.50000	0.16667	0.50	0.7082
Variety (Var)	1	32.0000	32.0000	96.00	0.0023
Interaction (Rep*Var)	3	1.00000	0.33333		
Total	7	33.5000			

Appendix 3.17: Analysis of variance table for *Aspergillus terreus* infestation in blackgram

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	3.409E-31	1.136E-31	0.00	1.0000
Variety (Var)	1	72.0000	72.0000	54.00	0.0052
Interaction (Rep*Var)	3	4.00000	1.33333		
Total	7	76.0000			

Appendix 3.18: Analysis of variance table for *Alternaria sp.* infestation in blackgram

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	0.37500	0.12500	0.27	0.8429
Variety (Var)	1	1.12500	1.12500	2.45	0.2152
Interaction (Rep*Var)	3	1.37500	0.45833		
Total	7	2.87500			

Appendix 3.19: Analysis of variance table for *Cladosporium sp.* infestation in blackgram

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	0.50000	0.16667	1.00	0.5000
Variety (Var)	1	0.50000	0.50000	3.00	0.1817
Interaction (Rep*Var)	3	0.50000	0.16667		
Total	7	1.50000			

Appendix 3.20: Analysis of variance table for *Curvularia sp.* infestation in blackgram

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	1.37500	0.45833	0.41	0.7599
Variety (Var)	1	28.1250	28.1250	25.00	0.0154
Interaction (Rep*Var)	3	3.37500	1.12500		
Total	7	32.8750			

Appendix 3.21: Analysis of variance table for *Fusarium sp.* infestation in blackgram

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	3.00000	1.00000	0.46	0.7291
Variety (Var)	1	1012.50	1012.50	467.31	0.0002
Interaction (Rep*Var)	3	6.50000	2.16667		
Total	7	1022.00			

Appendix 3.22: Analysis of variance table for *Macrophomina phaseolina* infestation in blackgram

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	2.37500	0.79167	1.00	0.5000
Variety (Var)	1	21.1250	21.1250	26.68	0.0141
Interaction (Rep*Var)	3	2.37500	0.79167		
Total	7	25.8750			

Appendix 3.23: Analysis of variance table for *Penicillium sp.* infestation in blackgram

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	1.37500	0.45833	1.00	0.5000
Variety (Var)	1	6.12500	6.12500	13.36	0.0354
Interaction (Rep*Var)	3	1.37500	0.45833		
Total	7	8.87500			

Appendix 3.24: Analysis of variance table for *Colletotrichum sp.* infestation in blackgram

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	0.37500	0.12500	1.00	0.5000
Variety (Var)	1	1.12500	1.12500	9.00	0.0577
Interaction (Rep*Var)	3	0.37500	0.12500		
Total	7	1.87500			

Appendix 3.25: Analysis of variance table for *Myrothecium sp.* infestation in blackgram

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	0.37500	0.12500	1.00	0.5000
Variety (Var)	1	0.12500	0.12500	1.00	0.3910
Interaction (Rep*Var)	3	0.37500	0.12500		
Total	7	0.87500			

Appendix 3.26: Analysis of variance table for seed germination (%) of blackgram after fungal infestation in blackgram

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (Rep)	3	4.50000	1.50000	0.69	0.6151
Variety (Var)	1	24.5000	24.5000	11.31	0.0436
Interaction (Rep*Var)	3	6.50000	2.16667		
Total	7	35.5000			

Appendix 7.01: Analysis of variance table for estimation of viability in mungbean seeds (variety Khampensaen 2) for normal seedling (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	1.50000	0.50000	0.16	0.9181
Status (B)	1	0.50000	0.50000	0.16	0.7177
Interaction (A*B)	3	9.50000	3.16667		
Total	7	11.5000			

Appendix 7.02: Analysis of variance table for estimation of viability in mungbean seeds (variety Khampensaen 2) for abnormal seedling (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	5.50000	1.83333	3.67	0.1571
Status (B)	1	6384.50	6384.50	12769.00	0.0000
Interaction (A*B)	3	1.50000	0.50000		
Total	7	6391.50			

Appendix 7.03: Analysis of variance table for estimation of viability in mungbean seeds (variety Khampensaen 2) for dead and rotten seed (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	2.00000	0.66667	1.00	0.5000
Status (B)	1	98.0000	98.0000	147.00	0.0012
Interaction (A*B)	3	2.00000	0.66667		
Total	7	102.000			

Appendix 7.04: Analysis of variance table for estimation of viability in mungbean seeds (variety Khampensaen 2) for hard seed (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	1.50000	0.50000	0.16	0.9181
Status (B)	1	0.50000	0.50000	0.16	0.7177
Interaction (A*B)	3	9.50000	3.16667		
Total	7	11.5000			

Appendix 7.05: Analysis of variance table for estimation of viability in mungbean seeds (variety Chai Nat 36) for normal seedling (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	17.5000	5.83333	3.18	0.1836
Status (B)	1	6844.50	6844.50	3733.36	0.0000
Interaction (A*B)	3	5.50000	1.83333		
Total	7	6867.50			

Appendix 7.06: Analysis of variance table for estimation of viability in mungbean seeds (variety Chai Nat 36) for abnormal seedling (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	12.0000	4.00000	1.00	0.5000
Status (B)	1	5408.00	5408.00	1352.00	0.0000
Interaction (A*B)	3	12.0000	4.00000		
Total	7	5432.00			

Appendix 7.07: Analysis of variance table for estimation of viability in mungbean seeds (variety Chai Nat 36) for dead and rotten seed (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	2.00000	0.66667	1.00	0.5000
Status (B)	1	98.0000	98.0000	147.00	0.0012
Interaction (A*B)	3	2.00000	0.66667		
Total	7	102.0000			

Appendix 7.08: Analysis of variance table for estimation of viability in mungbean seeds (variety Chai Nat 36) for hard seed (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	1.50000	0.50000	0.27	0.8429
Status (B)	1	0.50000	0.50000	0.27	0.6376
Interaction (A*B)	3	5.50000	1.83333		
Total	7	7.50000			

Appendix 7.09: Analysis of variance table for estimation of viability in mungbean seeds (variety Chai Nat 60) for normal seedlings (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	18.0000	6.00000	1.80	0.3206
Status (B)	1	7442.00	7442.00	2232.60	0.0000
Interaction (A*B)	3	10.0000	3.33333		
Total	7	7470.00			

Appendix 7.10: Analysis of variance table for estimation of viability in mungbean seeds (variety Chai Nat 60) for abnormal seedlings (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	12.0000	4.00000	3.00	0.1955
Status (B)	1	5832.00	5832.00	4374.00	0.0000
Interaction (A*B)	3	4.00000	1.33333		
Total	7	5848.00			

Appendix 7.11: Analysis of variance table for estimation of viability in mungbean seeds (variety Chai Nat 60) for dead and rotten seed (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	5.50000	1.83333	1.00	0.5000
Status (B)	1	84.5000	84.5000	46.09	0.0065
Interaction (A*B)	3	5.50000	1.83333		
Total	7	95.5000			

Appendix 7.12: Analysis of variance table for estimation of viability in mungbean seeds (variety Chai Nat 60) for hard seed (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	5.50000	1.83333	1.00	0.5000
Status (B)	1	0.50000	0.50000	0.27	0.6376
Interaction (A*B)	3	5.50000	1.83333		
Total	7	11.5000			

Appendix 7.13: Analysis of variance table for estimation of vigor of mungbean seeds (variety Khampensaen 2) for shoot length (cm).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	0.10765	0.03588	0.43	0.7462
Status (B)	1	28.9561	28.9561	347.96	0.0003
Interaction (A*B)	3	0.24965	0.08322		
Total	7	29.3134			

Appendix 7.14: Analysis of variance table for estimation of vigor of mungbean seeds (variety Khampensaen 2) for root length (cm).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	0.02050	0.00683	0.06	0.9782
Status (B)	1	11.3288	11.3288	97.47	0.0022
Interaction (A*B)	3	0.34870	0.11623		
Total	7	11.6980			

Appendix 7.15: Analysis of variance table for estimation of vigor of mungbean seeds (variety Khampensaen 2) for dry weight (g/100 seedlings).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	0.00234	7.792E-04	0.75	0.5927
Status (B)	1	0.31601	0.31601	302.16	0.0004
Interaction (A*B)	3	0.00314	0.00105		
Total	7	0.32149			

Appendix 7.16: Analysis of variance table for estimation of vigor of mungbean seeds (variety Chai Nat 36) for shoot length (cm).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	0.05725	0.01908	0.24	0.8610
Status (B)	1	15.7361	15.7361	201.87	0.0008
Interaction (A*B)	3	0.23385	0.07795		
Total	7	16.0272			

Appendix 7.17: Analysis of variance table for estimation of vigor of mungbean seeds (variety Chai Nat 36) for root length (cm).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	0.06454	0.02151	0.41	0.7577
Status (B)	1	7.74211	7.74211	148.00	0.0012
Interaction (A*B)	3	0.15694	0.05231		
Total	7	7.96359			

Appendix 7.18: Analysis of variance table for estimation of vigor of mungbean seeds (variety Chai Nat 36) for dry weight (g/100 seedlings).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	0.00444	0.00148	2.29	0.2569
Status (B)	1	0.53561	0.53561	829.34	0.0001
Interaction (A*B)	3	0.00194	6.458E-04		
Total	7	0.54199			

Appendix 7.19: Analysis of variance table for estimation of vigor of mungbean seeds (variety Chai Nat 60) for shoot length (cm).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	0.74425	0.24808	7.89	0.0618
Status (B)	1	34.2792	34.2792	1090.54	0.0001
Interaction (A*B)	3	0.09430	0.03143		
Total	7	35.1177			

Appendix 7.20: Analysis of variance table for estimation of vigor of mungbean seeds (variety Chai Nat 60) for root length (cm).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	0.08124	0.02708	0.55	0.6824
Status (B)	1	7.86061	7.86061	159.51	0.0011
Interaction (A*B)	3	0.14784	0.04928		
Total	7	8.08969			

Appendix 7.21: Analysis of variance table for estimation of vigor of mungbean seeds (variety Chai Nat 60) for dry weight (g/100 seedlings).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	0.00430	0.00143	14.33	0.0277
Status (B)	1	0.95220	0.95220	9522.00	0.0000
Interaction (A*B)	3	3.000E-04	1.000E-04		
Total	7	0.95680			

Appendix 7.22: Analysis of variance table for estimation of storability (AA-test) of mungbean seeds (variety Khampensaen 2) for normal seedlings (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	13.5000	4.50000	2.45	0.2401
Status (B)	1	2380.50	2380.50	1298.45	0.0000
Interaction (A*B)	3	5.50000	1.83333		
Total	7	2399.50			

Appendix 7.23: Analysis of variance table for estimation of storability (AA-test) of mungbean seeds (variety Khampensaen 2) for abnormal seedlings (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	1.50000	0.50000	0.27	0.8429
Status (B)	1	1512.50	1512.50	825.00	0.0001
Interaction (A*B)	3	5.50000	1.83333		
Total	7	1519.50			

Appendix 7.24: Analysis of variance table for estimation of storability (AA-test) of mungbean seeds (variety Khampensaen 2) for dead and rotten seed (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	10.0000	3.33333	5.00	0.1096
Status (B)	1	98.0000	98.0000	147.00	0.0012
Interaction (A*B)	3	2.00000	0.66667		
Total	7	110.000			

Appendix 7.25: Analysis of variance table for estimation of storability (AA-test) of mungbean seeds (variety Khampensaen 2) for hard seed (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	1.50000	0.50000	0.27	0.8429
Status (B)	1	0.50000	0.50000	0.27	0.6376
Interaction (A*B)	3	5.50000	1.83333		
Total	7	7.50000			

Appendix 7.26: Analysis of variance table for estimation of storability (AA-test) of mungbean seeds (variety Chai Nat 36) for normal seedlings (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	1.50000	0.50000	0.11	0.9480
Status (B)	1	1200.50	1200.50	266.78	0.0005
Interaction (A*B)	3	13.5000	4.50000		
Total	7	1215.50			

Appendix 7.27: Analysis of variance table for estimation of storability (AA-test) of mungbean seeds (variety Chai Nat 36) for abnormal seedlings (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	4.00000	1.33333	0.33	0.8045
Status (B)	1	512.000	512.000	128.00	0.0015
Interaction (A*B)	3	12.0000	4.00000		
Total	7	528.000			

Appendix 7.28: Analysis of variance table for estimation of storability (AA-test) of mungbean seeds (variety Chai Nat 36) for dead and rotten seeds (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	4.00000	1.33333	0.40	0.7642
Status (B)	1	162.000	162.000	48.60	0.0061
Interaction (A*B)	3	10.0000	3.33333		
Total	7	176.000			

Appendix 7.29: Analysis of variance table for estimation of storability (AA-test) of mungbean seeds (variety Chai Nat 36) for hard seed (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	5.50000	1.83333	1.00	0.5000
Status (B)	1	0.50000	0.50000	0.27	0.6376
Interaction (A*B)	3	5.50000	1.83333		
Total	7	11.5000			

Appendix 7.30: Analysis of variance table for estimation of storability (AA-test) of mungbean seeds (variety Chai Nat 60) for normal seedlings (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	18.00	6.000	4.50	0.1242
Status (B)	1	2048.00	2048.00	1536.00	0.0000
Interaction (A*B)	3	4.00	1.3333		
Total	7	2070.00			

Appendix 7.31: Analysis of variance table for estimation of storability (AA-test) of mungbean seeds (variety Chai Nat 60) for abnormal seedlings (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	12.00	4.00	1.20	0.4400
Status (B)	1	1250.00	1250.00	175.00	0.0003
Interaction (A*B)	3	10.00	3.33		
Total	7	1272.00			

Appendix 7.32: Analysis of variance table for estimation of storability (AA-test) of mungbean seeds (variety Chai Nat 60) for dead and rotten seed (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	4.00	1.333	0.40	0.764
Status (B)	1	98.00	98.00	29.40	0.012
Interaction (A*B)	3	10.00	3.333		
Total	7	112.00			

Appendix 7.33: Analysis of variance table for estimation of storability (AA-test) of mungbean seeds (variety Chai Nat 60) for hard seed (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	2.000	0.6667	0.50	0.7080
Status (B)	1	1.109E-31	1.109E-31	0.00	1.0000
Interaction (A*B)	3	4.000	1.3333		
Total	7	6.000			

Appendix 7.34: Analysis of variance table for estimation of viability of blackgram seeds (variety Phitsanulok 2) for normal seedlings (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	13.50	4.50	2.45	0.2401
Status (B)	1	7564.50	7564.50	4126.09	0.000
Interaction (A*B)	3	5.500	1.833		
Total	7	7583.50			

Appendix 7.35: Analysis of variance table for estimation of viability of blackgram seeds (variety Phitsanulok 2) for abnormal seedlings (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	9.500	3.167	6.33	0.0819
Status (B)	1	5724.50	5724.50	11449.00	0.000
Interaction (A*B)	3	1.500	0.500		
Total	7	5735.50			

Appendix 7.36: Analysis of variance table for estimation of viability of blackgram seeds (variety Phitsanulok 2) for dead and rotten seed (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	2.00	0.667	1.00	0.500
Status (B)	1	162.00	162.00	243.00	0.0006
Interaction (A*B)	3	2.00	0.667		
Total	7	166.00			

Appendix 7.37: Analysis of variance table for estimation of viability of blackgram seeds (variety Phitsanulok 2) for hard seed (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	2.00	0.667	0.20	0.8904
Status (B)	1	2.00	2.000	0.60	0.4950
Interaction (A*B)	3	10.00	3.333		
Total	7	14.00			

Appendix 7.38: Analysis of variance table for estimation of viability of blackgram seeds (variety Uthong 2) for normal seedlings (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	2.00	0.667	0.10	0.9548
Status (B)	1	4608.00	4608.00	691.20	0.0001
Interaction (A*B)	3	20.000	6.667		
Total	7	4630.00			

Appendix 7.39: Analysis of variance table for estimation of viability of blackgram seeds (variety Uthong 2) for abnormal seedlings (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	5.500	1.833	3.67	0.1571
Status (B)	1	3120.50	3120.50	6241.00	0.0000
Interaction (A*B)	3	1.500	0.500		
Total	7	3127.50			

Appendix 7.40: Analysis of variance table for estimation of viability of blackgram seeds (variety Uthong 2) for dead and rotten seed (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	4.000	1.333	1.000	0.5000
Status (B)	1	128.00	128.00	96.00	0.0023
Interaction (A*B)	3	4.000	1.333		
Total	7	136.00			

Appendix 7.41: Analysis of variance table for estimation of viability of blackgram seeds (variety Uthong 2) for hard seed (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	9.500	3.1667	1.00	0.500
Status (B)	1	0.500	0.500	0.16	0.7177
Interaction (A*B)	3	9.500	3.1667		
Total	7	19.500			

Appendix 7.42: Analysis of variance table for estimation of vigor of blackgram seeds (variety Phitsanulok 2) for shoot length (cm).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	0.336	0.112	12.55	0.0333
Status (B)	1	69.915	69.915	7844.64	0.0000
Interaction (A*B)	3	0.0267	0.009		
Total	7	70.278			

Appendix 7.43: Analysis of variance table for estimation of vigor of blackgram seeds (variety Phitsanulok 2) for root length (cm).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	0.177	0.059	0.92	0.528
Status (B)	1	7.431	7.431	115.72	0.002
Interaction (A*B)	3	0.193	0.064		
Total	7	7.800			

Appendix 7.44: Analysis of variance table for estimation of vigor of blackgram seeds (variety Phitsanulok 2) for dry weight (g/100 seedlings).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	0.003	0.001	11.00	0.0398
Status (B)	1	0.925	0.924	9248.00	0.000
Interaction (A*B)	3	3.000	1.000		
Total	7	0.928			

Appendix 7.45: Analysis of variance table for estimation of vigor of blackgram seeds (variety Uthong 2) for shoot length (cm).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	0.327	0.109	1.12	0.465
Status (B)	1	80.455	80.455	823.94	0.0001
Interaction (A*B)	3	0.293	0.098		
Total	7	81.075			

Appendix 7.46: Analysis of variance table for estimation of vigor of blackgram seeds (variety Uthong 2) for root length (cm).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	0.388	0.129	4.70	0.118
Status (B)	1	8.242	8.242	299.70	0.0004
Interaction (A*B)	3	0.083	0.028		
Total	7	8.712			

Appendix 7.47: Analysis of variance table for estimation of vigor of blackgram seeds (variety Uthong 2) for dry weight (g/100 seedlings).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	0.002	5.500E-04	1.10	0.4697
Status (B)	1	0.627	0.627	1254.40	0.0000
Interaction (A*B)	3	0.002	0.627		
Total	7	0.630	5.000E-04		

Appendix 7.48: Analysis of variance table for estimation of storability (AA-test) of blackgram seeds (variety Phitsanulok 2) for normal seedlings (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	12.000	4.0000	0.67	0.627
Status (B)	1	1682.00	1682.00	280.33	0.0005
Interaction (A*B)	3	18.000	6.000		
Total	7	1712.00			

Appendix 7.49: Analysis of variance table for estimation of storability (AA-test) of blackgram seeds (variety Phitsanulok 2) for abnormal seedlings (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	8.000	2.6667	1.00	0.5000
Status (B)	1	1352.00	1352.00	507.00	0.0002
Interaction (A*B)	3	8.000	2.667		
Total	7	1368.00			

Appendix 7.50: Analysis of variance table for estimation of storability (AA-test) of blackgram seeds (variety Phitsanulok 2) for dead and rotten seed (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	10.000	3.333	5.00	0.1096
Status (B)	1	18.000	18.000	27.00	0.0138
Interaction (A*B)	3	2.000	0.6667		
Total	7	30.000			

Appendix 7.51: Analysis of variance table for estimation of storability (AA-test) of blackgram seeds (variety Phitsanulok 2) for hard seed (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	6.375	2.125	1.89	0.3073
Status (B)	1	1.125	1.125	1.00	0.3910
Interaction (A*B)	3	3.375	1.125		
Total	7	10.875			

Appendix 7.52: Analysis of variance table for estimation of storability (AA-test) of blackgram seeds (variety Uthong 2) for normal seedlings (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	17.500	5.8333	1.30	0.4181
Status (B)	1	1860.50	1860.50	413.44	0.0003
Interaction (A*B)	3	13.5000	4.5000		
Total	7	1891.50			

Appendix 7.53: Analysis of variance table for estimation of storability (AA-test) of blackgram seeds (variety Uthong 2) for abnormal seedlings (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	1.5000	0.5000	0.09	0.9632
Status (B)	1	2244.50	2244.50	384.77	0.0003
Interaction (A*B)	3	17.5000	5.8333		
Total	7	2263.50			

Appendix 7.54: Analysis of variance table for estimation of storability (AA-test) of blackgram seeds (variety Uthong 2) for dead and rotten seed (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	1.0000	0.3333	0.33	0.8045
Status (B)	1	50.000	50.000	50.00	0.0058
Interaction (A*B)	3	3.0000	1.0000		
Total	7	54.000			

Appendix 7.55: Analysis of variance table for estimation of storability (AA-test) of blackgram seeds (variety Uthong 2) for hard seed (%).

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	9.5000	3.1667	1.73	0.3323
Status (B)	1	0.5000	0.5000	0.27	0.6376
Interaction (A*B)	3	5.5000	1.8333		
Total	7	15.500			

Appendix 8.01: Analysis of variance table for estimation of carbohydrate content in healthy and diseased seeds of mungbean and blackgram

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	0.01500	0.005	0.82	0.5157
Variety (B)	1	14.063	14.0625	2301.14	0.000
Status (C)	1	588.063	588.063	96228.41	0.000
Interaction (B*C)	1	18.063	18.063	2955.68	0.000
A*B*C	9	0.0550	0.0061		
Total	15	620.258			

Appendix 8.02: Analysis of variance table for estimation of protein content in healthy and diseased seeds of mungbean and blackgram

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	0.02055	0.00685	0.44	0.7282
Variety (B)	1	37.4544	37.4544	2420.75	0.0000
Status (C)	1	88.3600	88.3600	5710.88	0.0000
Interaction (B*C)	1	3.84160	3.84160	248.29	0.0000
A*B*C	9	0.13925	0.01547		
Total	15	129.816			

Appendix 9.01: List of chemical fungicides used as seed treatment

Trade Name	Common Name	Chemical Name
Benlate (50% WP) Fundazole 50 (50% WP) Bavisan 50 WP Bedazin 50 (50% WP) Tersan-1991 Ultra-Sofril Grex	Benomyl	Methyl 1-(buthyl carbamoyl)-2-benzimidazole carbamate
Kapricide 50 (50% WP) Watacide 50 (50% WP) Captafez 50 (50% WP) Orthocide 50 WP Twincocide 50 WP Carbicide 50 (50% WP) Captan 50-WP Captaincide 50 WP Merpan Vondcaptan Captane	Captan	N-(Trichloromethylthio)-4-cyclohexone-1,2-dicarbiximide
Vitavax 75 (carbixin) Vitavax (75% WP) D.C.M.O. Vitavax	Carbixin (DMOC)	5,6-Dihydro-2-methyl-1,4-oxathin-3-carbixanilide
Tersan 75 (75% WP) TMTD Thylate Arasan 75 Vancide TM-95 Fernasan	Thiram	Tetramethylthiuramdisulfide
Apron 35 Ridomil (25% WP) Ridomil (1.0 G)	Metalexyl	Methyl DL-N-(2,6-dimethyl phynyl)-N(2, methoxyacetyl)-alaninate
Dithane M-45 (80% WP) Manzate 200 Fore Mancofol	Mencozeb (maneb+zineb)	Manganese ion(16%)+Zinc ion (2%)+Ethylene bisdithiocarbamate ion (62%)

Appendix 9.02: Amount of different fungicides mixed with liquid PDA.

Name of fungicides	Weight of fungicides (gm) which was mixed with 100ml liquid PDA		
	Below normal dose	Normal dose	Above normal dose
Thiram	0.076	0.086	0.100
Metalexyl	0.700	0.850	1.000
Captan	0.150	0.170	0.200
Dithane M-45	0.150	0.170	0.200
Vitavax	0.073	0.100	0.126
Benlate	0.073	0.113	0.153

Appendix 9.03: Analysis of variance table for effect of hot water treatment on germination of mungbean seed when the seeds were planted in plastic pots with sterilized soil.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication	3	1.000	0.333	0.05	0.984
(Aggregation)	1	1250.00	1250.00	178.57	0.0009
Status (B)	3	21.000	7.000		
Interaction (A*B)	7	1272.00			
Total					

Appendix 9.04: Analysis of variance table for effect of hot water treatment on *Macrophomina phaseolina* infection of mungbean seed when the seeds were planted in plastic pots with sterilized soil.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication	3	4.000	1.333	0.140	0.928
(Aggregation)	1	1682.00	1682.00	180.21	0.0009
Status (B)	3	28.000	9.333		
Interaction (A*B)	7	1714.00			
Total					

Appendix 9.05: Analysis of variance table for effect of hot water treatment on healthy seedling production from mungbean seed when the seeds were planted in plastic pots with sterilized soil.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication	3	7.000	2.3333	0.23	0.874
(Aggregation)	1	1250.00	1250.00	120.97	0.0016
Status (B)	3	31.000	10.333		
Interaction (A*B)	7	1288.00			
Total					

Appendix 9.06: Analysis of variance table for effect of hot water treatment on germination of blackgram seed when the seeds were planted in plastic pots with sterilized soil.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication	3	13.000	4.333	0.62	0.648
(Aggregation)	1	722.000	722.00	103.14	0.002
Status (B)	3	21.000	7.000		
Interaction (A*B)	7	756.000			
Total					

Appendix 9.07: Analysis of variance table for effect of hot water treatment on *Macrophomina phaseolina* infection of blackgram seed when the seeds were planted in plastic pots with sterilized soil.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication	3	19.000	6.333	1.46	0.381
(Aggregation)	1	1250.00	1250.00	288.46	0.0004
Status (B)	3	13.000	4.333		
Interaction (A*B)	7	1282.00			
Total					

Appendix 9.08: Analysis of variance table for effect of hot water treatment on healthy seedling production from blackgram seed when the seeds were planted in plastic pots with sterilized soil.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication	3	1.000	0.333	0.05	0.981
(Aggregation)	1	882.00	882.00	139.26	0.001
Status (B)	3	19.000	6.333		
Interaction (A*B)	7	902.00			
Total					

Appendix 9.09: Analysis of variance table for effect of chemical seed treatment on germination of mungbean seed when the seeds were planted in plastic pots with sterilized soil.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication (A)	3	10.500	3.5000	0.47	0.723
Treatment (B)	3	2276.00	758.667	101.16	0.000
Interaction (A*B)	9	67.5000	7.5000		
Total	15	2354.00			

Appendix 9.10: Analysis of variance table for effect of chemical seed treatment on *Macrophomina phaseolina* infection of mungbean seed when the seeds were planted in plastic pots with sterilized soil.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication	3	6.250	2.0833	0.90	0.4766
(Aggregation)	3	3040.75	1013.58	439.63	0.0000
Treatment (B)	9	20.750	2.3056		
Interaction (A*B)	15	3067.75			
Total					

Appendix 9.11: Analysis of variance table for effect of chemical seed treatment on healthy seedling production from mungbean seed when the seeds were planted in plastic pots with sterilized soil.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication	3	5.500	1.8333	0.30	0.8228
(Aggregation)	3	2483.00	827.667	136.68	0.0000
Treatment (B)	9	54.5000	6.0556		
Interaction (Aggregation*B)	15	2543.00			
Total					

Appendix 9.12: Analysis of variance table for effect of chemical seed treatment on germination of blackgram seed when the seeds were planted in plastic pots with sterilized soil.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication	3	3.5000	1.1667	0.16	0.9219
(Aggregation)	3	1563.00	521.00	70.51	0.0000
Treatment (B)	9	66.500	7.3889		
Interaction (A*B)	15	1633.00			
Total					

Appendix 9.13: Analysis of variance table for effect of chemical seed treatment on *Macrophomina phaseolina* infection of blackgram seed when the seeds were planted in plastic pots with sterilized soil.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication	3	5.250	1.750	1.00	0.4363
(Aggregation)	3	2160.75	720.250	411.57	0.0000
Treatment (B)	9	15.750	1.7500		
Interaction (Aggregation*B)	15	2181.75			
Total					

Appendix 9.14: Analysis of variance table for effect of chemical seed treatment on healthy seedling production from blackgram seed when the seeds were planted in plastic pots with sterilized soil.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication	3	28.500	9.5000	1.97	0.1898
(Aggregation)	3	1880.00	626.667	129.66	0.000
Treatment (B)	9	43.500	4.8333		
Interaction (Aggregation*B)	15	1952.00			
Total					

Appendix 9.15: Analysis of variance table for effect of biological seed treatment on germination of mungbean seed when the seeds were planted in plastic pots with sterilized soil.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication	3	23.500	7.8333	1.83	0.2117
(Aggregation)	3	2115.00	705.000	164.81	0.0000
Treatment (B)	9	38.500	4.27778		
Interaction (A*B)	15	2177.00			
Total					

Appendix 9.16: Analysis of variance table for effect of biological seed treatment on *Macrophomina phaseolina* infection of mungbean seed when the seeds were planted in plastic pots with sterilized soil.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication	3	10.500	3.5000	1.07	0.4102
(Aggregation)	3	2832.00	944.00	288.00	0.000
Treatment (B)	9	29.500	3.2778		
Interaction (A*B)	15	2872.00			
Total					

Appendix 9.17: Analysis of variance table for effect of biological seed treatment on healthy seedling production from mungbean seed when the seeds were planted in plastic pots with sterilized soil.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication	3	30.5000	10.1667	1.85	0.2087
(Aggregation)	3	2219.00	739.667	134.48	0.000
Treatment (B)	9	49.500	5.500		
Interaction (A*B)	15	2299.00			
Total					

Appendix 9.18: Analysis of variance table for effect of biological seed treatment on germination of blackgram seed when the seeds were planted in plastic pots with sterilized soil.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication	3	38.5000	12.833	3.45	0.0650
(Aggregation)	3	1531.00	510.33	137.10	0.000
Treatment (B)	9	33.500	3.7222		
Interaction (A*B)	15	1603.00			
Total					

Appendix 9.19: Analysis of variance table for effect of biological seed treatment on *Macrophomina phaseolina* infection of blackgram seed when the seeds were planted in plastic pots with sterilized soil.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication	3	2.000	0.6667	0.23	0.8727
(Aggregation)	3	1987.00	662.333	229.27	0.0000
Treatment (B)	9	26.000	2.8889		
Interaction (A*B)	15	2015.00			
Total					

Appendix 9.20: Analysis of variance table for effect of biological seed treatment on healthy seedling production from blackgram seed when the seeds were planted in plastic pots with sterilized soil.

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F	Significant at P value
Replication	3	23.250	7.7500	2.51	0.1243
(Aggregation)	3	1638.75	546.250	177.16	0.0000
Treatment (B)	9	27.750	3.0833		
Interaction (A*B)	15	1689.75			
Total					

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