INFLUENCE OF SEED PRIMING ON RESULTANT SEEDS OF SOYBEAN [GLYCINE MAX (L.) MERILL] VARIETIES

N.G. CHAVAN, L.N.TAGAD

Abstract: The beneficial effects of seed priming have been demonstrated for many field crops. The objective of this study was to study the effect of seed priming on harvested seeds of soybean (Glycine max L.) varieties. The present investigation was carried out in the Seed Technology Research Unit laboratory and field experiment at PGI farm, Department of Agricultural Botany, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (M.S) during December 2010 to November 2012. There were two varieties viz., Phule Kalyani and JS-335 while six priming treatments viz., Control (unprimed seeds), Hydropriming, KCl @10 ppm, $CaCl_2.2H_2O$ @ 0.5 %, KH_2PO_4 @ 50 ppm and GA_3 @ 20 ppm. The variety Phule Kalyani primed with $CaCl_2.2H_2O$ (0.5%) were superior in 100 seed weight, germination percentage, root length, shoot length, vigour index and electric conductivity of harvested seeds over those raised from the variety JS-335.

Keywords: Soybean, hydroprimng, electric conductivity, vigour index.

Introduction: Seed pretreatment increased seed germination and vigour index (8). The few studies available using the chemical seed priming in soybean seeds are promising, but their use as routine in seed quality enhancement and commercial application depends on getting more detailed information about the storability, biochemical changes, their performance in the field and also on resultant seeds. According to published results of different studies, osmo-priming improved seedling establishment in the field. This plant is an ecological advantage. At the beginning of the growing season competition between crop and weed has not been serious forms. In addition to environmental inputs such as water and light is abundance for the new established plant. In such a case, rapid germination, early establishment and uniform field of green can make better use of inputs are available (16). The harvested yield from such farms would be better in terms of quality and quantity. The purpose of this study was to evaluate the effect of seed priming on harvested seed vigor of soybean.

Soybean [Glycine max (L.) Merill] is one of the most important protein and oil seed crop throughout the world. Its oil is the largest component of the world's edible oils. The world production of edible oils consists of 30 per cent soybean. It is an ingredient of more than 50% of the world's high protein meal. The native of soybean is Eastern Asia. Soybean was introduced to India during 1880.

Seed priming is basically a pre-sowing seed treatment. Primed and dried seeds normally have a more rapid and uniform germination when subsequently re-hydrated, especially under adverse environmental conditions (6). The mechanism of seed drying after chemical priming is known as the hydration-dehydration process or dry back and is used to reduce the degree of moisture in seeds to levels compatible with storage and maintaining the beneficial effects of the treatment, without quality loss caused by rapid seed deterioration. Park reported that the priming aged seeds of soybean resulted in good germination and stand Seed pretreatment establishment in the field trials (13).

Material and methods: Samples of 500 grams of soybean seeds Cv. JS- 335 (V1) and Phule Kalyani (V2) were placed between germination towels wetted with tap water of pH 6.5 for 14 hour. Afterwards, primed seeds were allowed to dry back to their original moisture content under the shad for one day and in the sun for two days then stored and same seed used for sowing in kharif. The harvested primed seeds were evaluated for seed quality parameters as below.

Hundred seed weight: Hundred seed in each treatment was counted manually and the weight was recorded as per the procedure given by ISTA rules (Anon., 1999). The average hundred seed weight was recorded in grams.

Germination percentage: Four replications each of 100 seeds from respective treatments were used for germination by using between paper method (BP). The seed was germinated at 25 ± 20C in germinator for 8 days (2). The seeds were categorized into normal seedling, abnormal seedling, hard seed and dead seed. The germination percentage was recorded on the basis of normal seedlings only.

Root length: Ten normal seedlings were selected randomly in each treatment from all the replications on eighth day from germination test. The root length was measured from the tip of the primary root to base of hypocotyle with the help of a scale and mean root length was expressed in centimeters.

Shoot length: The ten normal seedlings used for root length measurement, were also used for the measurement of shoot length. The shoot length was measured form the tip of the primary leaf to the base of the hypocotyle and mean shoot length was expressed in centimeter.

Seedling dry weight: The ten normal seedlings used for root and shoot length measurements were put in butter paper pocket and kept in hot air oven at 70 ± 10C for 24 hour. The dry weight of the seedlings was recorded and expressed in grams.

Vigour index: The seeding vigour index was calculated by adopting the method suggested by Abdul Baki and Anderson (1973) and expressed in number by using below formula.

Vigour index I = Seedling length (cm) x Germination percentage

Vigour index II = Dry matter (g) x Germination percentage

Electrical conductivity: Five grams of seeds from each treatment in three replications were weighed and soaked in 25 ml distilled water in a beaker and kept at 25 ± 10C temperature. After 24 hour of soaking the solution was decanted and the volume was made up to 25 ml by adding distilled water. The electrical conductivity of the leachate was measured d Sm-1 (14).

Statistical analysis: The data were statistically analyzed using analysis of variance appropriate completely randomized design. Main and interaction effects were compared using LSD test at 0.05 level of probability, when the F-values were significant (17).

Results and discussion: Quality parameters assessed on the resultant seeds differ significantly due to the difference in varieties. Higher germination (96.71%), root length (20.54cm), shoot length (16.87cm), seedling dry weight (1.398 g), vigour index I (3611.7), vigour index II (135.16) leachate of electrolytes (0.284 dSm-1) were recorded in the seed harvested from the plots sown with the seeds of JS-335 variety over (95.58%, 19.74cm, 16.39cm, 1.212 g, 3459.3, 115.90 and 0.302 dSm-1, respectively) seeds harvested from plots sown with Phule Kalyani (V2) recorded significantly high 100 seed weight (13.53 g) over those raised from the JS-335 variety seeds (V1) (13.33 g). The better performance of seeds obtained from JS-335 variety tested for seed quality parameters after harvest, is presumably due to the genetic characters of that variety.

The priming treatments had significant influence in the resultant seed across all the parameters tested but not in germination percentage. Higher germination percentage was recorded in seeds obtained from plots having seed primed with $CaCl_2.2H_2O$ (0.5%) (T4) (97.00%), followed by the resultant seeds harvested from plots having seeds primed with GA3 (20 ppm) (T6) (96.63%) and KH_2PO_4 (50 ppm) (T5) (96.31%), however the results were non-significant. The lowest was observed in plots having unprimed seeds (95.06%). However, root length, shoot length, seedling dry weight, vigour index I, vigour index II and electrical conductivity were significantly affected. These tested seed quality parameters were all in favour of the resultant seeds obtained from plots sown with seed having primed with $CaCl_2.2H_2O$ (0.5%) (T4), (20.56 cm, 17.03 cm, 1.322 g, 3644.4, 128.32 and 0.273 dSm-1, respectively), followed by those obtained from plots sown with GA3 (20 ppm) (T6) (20.23 cm, 16.95 cm, 1.310 g, 3593.7, 126.62 and 0.276 dSm-1 ,respectively) primed seeds as judged against the least favoured resultant seeds obtained from plots sown with unprimed seeds, control (T1) (19.74 cm, 16.23 cm, 1.294 g, 3426.2, 123.06 and 0.320 dSm-1, respectively). The plots having seed primed with $CaCl_2.2H_2O$ (0.5%) (T4) showed significantly highest 100 seed weight (13.63 g). The possible reason for such differences in quality of the resultant seeds may be ascribed to significant carry over effect of the chemicals on the vigour and viability of seeds produced by plants from the pre-primed seeds.

The higher germination noticed in $CaCl_2.2H_2O$ (0.5%) (T4), primed seeds might be due to the role of calcium in membrane integrity. Christiansen and Foy and Hecht-Buchholz reported seed calcium concentration and germination percentage were positively related suggesting the role of calcium as an important component in membrane stabilization and as an enzyme cofactor (7). Kathiresan, Kulkarni and Eshanna, Nagappa reported similar beneficial results on germination and field emergence of sunflower by osmoprimimng in calcium chloride (7,10,11).

According to Salisbury and Ross, gibberellic acid is the growth regulator that truly acts on seed germination, showing a favourable action on the breaking of dormancy(16). Furthermore, Bradford et al. (2000) proposed that the endogenous GA3 control germination through two processes: a decrease in the mechanical resistance of the tissues surrounding the embryo and promotion of the growth potential of the embryo.

KH_2PO_4 also showed a relatively positive effect presumably because phosphorous activates the respiratory enzymes involved in the biosynthesis of seed. Beneficial effects of KCl have been reported by (20) in black gram, Rajandran in red gram, Basha in green gram and (19) in black gram and green gram. Hydroprimed seeds also showed better seed quality parameter when compared with the unprimed seeds (control). The beneficial effects of soaking soybean seeds in water were also reported by (4, 12).

The possible reason for such differences in quality of the resultant seeds may be ascribed to significant carry over effect of the chemicals on the vigour and viability of seeds produced by plants from the pre-primed seeds

Conclusion: On the basis of these observations, it may be concluded that soybean seeds positively responded to treatments of priming. Overall, osmopriming performed better than hydropriming.

Calcium chloride primed seeds, however, showed better
performance than the other treatments. There are variations between soybean varieties in response to priming. Nevertheless, priming generally improves the most parameters of soybean varieties through improving 100 seed weight, germination percentage, root length, shoot length, vigour index and electric conductivity of harvested seeds. The highest benefit of priming can be obtained from seeds primed with $CaCl_2.2H_2O$ (0.5%) treatment.

References:

1. Abdul-Baki, A. S. and Anderson, J. D. 1973. Vigour determination in soybean by multiple criteria. Crop Sci., 13: 630-633.
2. Anonymous. 1999. International rules for seed testing. Seed Sci. and Technol. 27: 27-32.
3. M. Basha,. 1982. Effect of chemical fortification of seeds on storability, field performance and quality of the resultant seeds in greengram. M.Sc. (Agri.) Thesis, Tamil Nadu Agricultural University, Coimbatore.
4. R. N.Basu, and Choudhary, P. 2005. Partitioning of assimilates in soybean seedlings. Annals Agril. Res., 11: 285-288.
5. K. J. Bradford, 1986. Manipulation of seeds water relations via osmotic priming to improve germination under stress conditions. Hort. sci., 59 (2): 672-676.
6. K. J.Bradford, , Chen. F., Cooley, M. B., Dhal, P., Downie, B., Fukunaga, K. K., Gee, O. H., Gurusinghe, S., Mella, R. A., Nonogaki, H. 2000. Gene expression prior to radicle emergence in imbibed tomato seeds. In Black, M., Bradford, K.J., and Vazquez-Ramos,.J. (Eds.), Seed Biology Advances and Applications (Pp. 231-251). Oxon, UK: CAB International.
7. M. N. Christiansen, and Foy, C. D. 1979. Fate and function of calcium in tissue. Commun. Soil Sci. Plant Anal., 10: 427-442..
8. W. E. Finch-Savage, Dent, K. C. and Clark, L. J. 2004. Soak conditions and temperatur temperature following sowing influence the response of maize (Zea mays L.) Field Crops Res., 90: 361-374
9. K., K Kathiresan, Kalyani, V. and Gnanarethinam, J. L. 1984. Effect of seed treatments on field emergence, early growth and some physiological process of sunflower (Helianthus annuus L.). Field Crop Res., 9 (3/4): 215-217.
10. N. G. Kulkarni, and Eshanna, M. R. 1988. Effect of pre-soaking of maize seeds on seed quality. Seed Res., 16 (1): 37-40.
11. D.Nagappa, 1983. Studies on pre-sowing seed hardening in sunflower: effect on growth and productivity. Mysore J. Agric Sci., 17 (1): 94.
12. U.G.Nalawadi,.,Prithviraj, S. and Krishnmurthy, K. 1973. Improvement in seed germination of soybean varieties by pre-soaking treatments. Indian J. Agric. Sci., 43: 546- 550.
13. N. Park, Song, J. and Sangyang, L. 1997. Effects of precooling and packaging methods on the vegetable soybean storage. RADJ. Crop Sci., 39: 46-52.
14. J. T. Presley, 1958. Relations of protoplast permeability of cotton seed viability and predeposition of disease. Pl. Disease Report, 42: 582.
15. P. Rajandran1982. Effect of chemical infusion of seeds on storability, field performance and quality of the resultant seeds in redgram Cv. CO 4. M.Sc. (Agri.) Thesis Tamil Nadu Agricultural University, Coimbatore.
16. F. B. Salisbury, and Ross, C. W. 1992. Plant Physiology. Wadsworth Publishing Company, Belmont. 682.
17. R. G. D.Steel, and Torrie, J.H. 1984. Principles and procedures of statistics, 2nd ed. pp. 172- 177. McGraw Hill Book Co.,Singapore
18. K.D. Subedi, and Ma, B.L. 2005. Seed priming does not improve corn yield in a humid temperate environment. Agron J., 97: 211-218.
19. K Vanangamudi,. and Karivaratharaju, T. V. 1986. Effect of pre-storage chemical fortification of seeds on shelf-life of greengram, blackgram and greengram seeds. Seed Sci. Technol., 14 (2): 477-482.
20. Vijayakumar, A. 1982. Efect of chemical impregnation of seeds on storability, field performance and quality of the resultant seeds in blackgram (Vigna mungo (L.) Hepper; syn; Phaeolous mungo L. (Cv. CO.5). M.Sc. (Agri.) Thesis, Tamil Nadu Agricultural University, Coimbatore.

***

Dr. N. G. Chavan/ Department of Botany/ MPKV/Rahuri. 413 722/
Dist –Ahmednagar (M. S.) /ngchavan86@gmail.com
Dr. L. N. Tagad/ Sr. Res. Asstt. Department of Botany/ MPKV/ Rahuri. 413 722/
Dist –Ahmednagar (M. S.)/lntagad@gmail.com

Table 1: 100 seed weight (g) and germination (%) of resultant soybean seeds as affected by varieties (V), seed priming treatments (T) and their interactions (VXT)

Treatments	100 seed weight (g)			Germination (%)					
Varieties	2011	2012	Pooled	2011		2012		Pooled	
V_1: JS-335	13.85	13.70	13.77	96.92	*80.21*	96.50	*79.49*	96.71	*79.60*
V_2: DS-228	14.05	13.89	13.97	95.88	*78.48*	95.29	*77.62*	95.58	*78.29*
S.E. ±	0.06	0.05	0.01		*0.47*		*0.47*		*0.12*
C. D. at 5%	0.18	0.14	0.03		*1.36*		*1.35*		*0.35*
Priming treatments									
T_1: Control	13.49	13.34	13.42	95.25	*83.25*	94.88	*82.73*	95.06	*82.92*
T_2: Water	13.81	13.70	13.75	96.00	*84.28*	95.38	*83.54*	95.69	*83.78*
T_3: Potacium Chloride	14.03	13.87	13.95	96.38	*84.76*	96.00	*84.24*	96.19	*84.39*
T_4: Calcium Chloride	14.15	13.99	14.07	97.13	*85.92*	96.75	*85.28*	96.94	*85.41*
T_5: Pot.di-hy.phosphate	14.12	13.98	14.05	97.00	*85.67*	96.25	*84.63*	96.63	*85.01*
T_6: Gibrelic acid	14.08	13.89	13.99	96.63	*85.12*	96.13	*84.37*	96.38	*84.66*
S.E. ±	0.10	0.08	0.02		*0.82*		*0.82*		*0.21*
C. D. at 5%	0.30	0.24	0.05		*NS*		*NS*		*0.61*
Interactions									
V_1T_1: JS-335+ Control	13.45	13.25	13.35	95.75	*78.19*	95.75	*78.31*	95.75	*78.10*
V_1T_2: JS-335+ Water	13.73	13.57	13.65	96.50	*79.36*	95.75	*78.38*	96.13	*78.66*
V_1T_3: JS-335+ Potacium Chloride	13.94	13.79	13.87	97.00	*80.21*	96.50	*79.36*	96.75	*79.62*
V_1T_4: JS-335+ Calcium Chloride	14.01	13.87	13.94	97.75	*81.75*	97.50	*81.15*	97.63	*81.14*
V_1T_5: JS-335+ Pot.di-hy.phosphate	13.99	13.88	13.93	97.50	*81.15*	96.75	*79.96*	97.13	*80.26*
V_1T_6: JS-335+ Gibrelic acid	13.97	13.83	13.90	97.00	*80.21*	96.75	*79.75*	96.88	*79.82*
V_2T_1: DS-228+ Control	13.53	13.43	13.48	94.75	*76.82*	94.00	*75.89*	94.38	*76.29*
V_2T_2: DS-228+ Water	13.88	13.82	13.85	95.50	*77.99*	95.00	*77.24*	95.25	*77.42*
V_2T_3: DS-228+ Potacium Chloride	14.12	13.94	14.03	95.75	*78.31*	95.50	*77.85*	95.63	*77.93*
V_2T_4: DS-228+ Calcium Chloride	14.29	14.11	14.20	96.50	*79.51*	96.00	*78.70*	96.25	*78.84*
V_2T_5: DS-228+ Pot.di-hy.phosphate	14.26	14.08	14.17	96.50	*79.36*	95.75	*78.19*	96.13	*78.66*
V_2T_6: DS-228+ Gibrelic acid	14.19	13.95	14.07	96.25	*78.90*	95.50	*77.85*	95.88	*78.29*
Mean	**13.95**	**13.79**	**13.87**	**96.40**	***84.83***	**95.90**	***84.13***	**96.15**	***84.36***

S.E. ±	0.15	0.12	0.02		*1.16*		*1.16*		*0.30*
C. D. at 5%	NS	NS	NS		*NS*		*NS*		*NS*

Table 2: Root length (cm), shoot length (cm) and dry weight (g) of resultant soybean seedlings as affected by varieties (V), seed priming treatments (T) and their interactions (VXT)

Treatments	**Root length (cm)**			**Shoot length (cm)**			**Dry weight (g)**		
Varieties	2011	2012	Pooled	2011	2012	Pooled	2011	2012	Pooled
V_1: JS-335	20.84	20.12	20.48	17.09	16.63	16.86	1.405	1.390	1.398
V_2: DS-228	20.07	19.54	19.81	16.59	16.16	16.38	1.220	1.205	1.212
S.E. ±	0.05	0.10	0.14	0.06	0.05	0.10	0.003	0.004	0.003
C. D. at 5%	0.15	0.27	0.43	0.16	0.15	0.30	0.008	0.012	0.011
Priming treatments									
T_1: Control	20.17	19.46	19.81	16.48	15.98	16.23	1.305	1.282	1.294
T_2: Water	20.30	19.65	19.97	16.56	16.05	16.30	1.309	1.286	1.298
T_3: Potacium Chloride	20.46	19.73	20.09	16.84	16.28	16.56	1.314	1.293	1.304
T_4: Calcium Chloride	20.67	20.48	20.57	17.17	16.83	17.00	1.326	1.319	1.322
T_5: Pot.di-hy.phosphate	20.63	19.84	20.24	17.11	16.57	16.84	1.314	1.301	1.307
T_6: Gibrelic acid	20.53	19.86	20.19	16.90	16.68	16.79	1.308	1.303	1.306
S.E. ±	0.09	0.16	0.24	0.10	0.09	0.17	0.005	0.007	0.006
C. D. at 5%	0.25	0.47	0.73	0.28	0.27	0.52	0.13	0.020	0.19
Interactions									
V_1T_1: JS-335+ Control	20.56	19.79	20.17	16.83	16.19	16.51	1.399	1.373	1.386
V_1T_2: JS-335+ Water	20.70	20.01	20.36	16.94	16.32	16.63	1.399	1.377	1.388
V_1T_3: JS-335+ Potacium Chloride	20.84	20.15	20.49	17.06	16.48	16.77	1.404	1.385	1.395
V_1T_4: JS-335+ Calcium Chloride	21.02	20.36	20.69	17.33	17.04	17.19	1.419	1.411	1.415
V_1T_5: JS-335+ Pot.di-hy.phosphate	21.00	20.22	20.61	17.29	16.96	17.13	1.408	1.400	1.404
V_1T_6: JS-335+ Gibrelic acid	20.92	20.21	20.57	17.11	16.79	16.95	1.401	1.395	1.398
V_2T_1: DS-228+ Control	19.77	19.12	19.45	16.12	15.76	15.94	1.211	1.192	1.202
V_2T_2: DS-228+ Water	19.89	19.28	19.59	16.19	15.77	15.98	1.219	1.195	1.207
V_2T_3: DS-228+ Potacium Chloride	20.07	19.31	19.69	16.61	16.07	16.34	1.223	1.201	1.212
V_2T_4: DS-228+ Calcium Chloride	20.31	20.59	20.45	17.02	16.61	16.81	1.232	1.227	1.230
V_2T_5: DS-228+ Pot.di-hy.phosphate	20.26	19.46	19.86	16.94	16.18	16.56	1.220	1.202	1.211
V_2T_6: DS-228+ Gibrelic acid	20.14	19.50	19.82	16.70	16.58	16.64	1.215	1.212	1.214
Mean	**20.46**	**19.83**	**20.15**	**16.84**	**16.40**	**16.62**	**1.313**	**1.297**	**1.305**
S.E. ±	0.12	0.23	0.34	0.14	0.13	0.24	0.006	0.010	0.009
C. D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 3: Electric conductivity (dSm^{-1}), vigour index I and vigour index II of resultant soybean seeds As affected by varieties (V), seed priming treatments (T) and their interactions (VX).

Treatments	Vigour index I			Vigour index II			Electric conductivity (dSm^{-1})		
Varieties	2011	2012	Pooled	2011	2012	Pooled	2011	2012	Pooled
V_1: JS-335	3676.5	3547.0	3611.7	136.18	134.14	135.16	0.265	0.303	0.284
V_2: DS-228	3515.9	3402.6	3459.3	116.98	114.83	115.90	0.279	0.325	0.302
S.E. ±	12.1	13.8	25.8	0.44	0.55	0.46	0.003	0.006	0.001
C. D. at 5%	34.6	39.5	79.5	1.26	1.59	1.42	0.009	0.018	0.004
Priming treatments									
T_1: Control	3490.3	3362.1	3426.2	124.37	121.75	123.06	0.298	0.343	0.320
T_2: Water	3538.8	3404.4	3471.6	125.71	122.70	124.21	0.290	0.338	0.314
T_3: Potacium Chloride	3594.1	3456.6	3525.3	126.67	124.21	125.44	0.268	0.312	0.290
T_4: Calcium Chloride	3680.0	3608.9	3644.4	128.97	127.67	128.32	0.253	0.293	0.273
T_5: Pot.di-hy.phosphate	3661.6	3500.1	3580.9	127.50	125.07	126.29	0.255	0.297	0.276
T_6: Gibrelic acid	3612.3	3516.9	3564.6	126.26	125.48	125.87	0.267	0.304	0.285
S.E. ±	20.9	23.8	44.7	0.76	0.96	0.80	0.005	0.011	0.002
C. D. at 5%	60.0	68.4	NS	2.19	2.74	2.46	0.016	0.031	0.007
Interactions									
V_1T_1: JS-335+ Control	3579.8	3445.6	3512.7	133.97	131.48	132.72	0.287	0.334	0.311
V_1T_2: JS-335+ Water	3631.7	3479.0	3555.4	135.05	131.84	133.45	0.284	0.328	0.306
V_1T_3: JS-335+ Potacium Chloride	3676.2	3534.0	3605.1	136.20	133.67	134.93	0.263	0.301	0.282
V_1T_4: JS-335+ Calcium Chloride	3749.0	3646.7	3697.8	138.72	137.56	138.14	0.246	0.281	0.264
V_1T_5: JS-335+ Pot.di-hy.phosphate	3734.1	3597.3	3665.7	137.30	135.39	136.35	0.246	0.284	0.265
V_1T_6: JS-335+ Gibrelic acid	3688.3	3579.4	3633.8	135.84	134.91	135.38	0.264	0.293	0.278
V_2T_1: DS-228+ Control	3400.9	3278.7	3339.8	114.77	112.03	113.40	0.309	0.352	0.330
V_2T_2: DS-228+ Water	3445.9	3329.7	3387.8	116.37	113.57	114.97	0.297	0.348	0.323
V_2T_3: DS-228+ Potacium Chloride	3512.0	3379.1	3445.6	117.14	114.75	115.95	0.272	0.324	0.298
V_2T_4: DS-228+ Calcium Chloride	3610.9	3571.1	3591.0	119.23	117.79	118.51	0.261	0.305	0.283
V_2T_5: DS-228+ Pot.di-hy.phosphate	3589.1	3402.9	3496.0	117.70	114.76	116.23	0.264	0.310	0.287
V_2T_6: DS-228+ Gibrelic acid	3536.4	3454.4	3495.4	116.67	116.06	116.37	0.270	0.314	0.292
Mean	**3596.2**	**3474.8**	**3535.5**	**126.58**	**124.48**	**125.53**	**0.272**	**0.314**	**0.293**
S.E. ±	29.6	33.7	63.2	1.08	1.36	1.13	0.007	0.015	0.003
C. D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS