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Short Communication

Fatty acid profile of advanced breeding lines of soybean under All India Coordinated Research Project

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The worth of a promising soybean breeding line submitted in All India Coordinated Research Project on Soybean (AICRPS) is normally judged from its yield performance or resistance against important pest for the release of an entry as a variety. However, lately, it is being felt that soybean varieties should be developed with output traits better suited for oil quality traits. Oil industries are raising requirements of soybean varieties that yield oil with better natural shelf life as partial hydrogenation done to increase oxidative stability is not only cost ineffective but leads to formation of trans fatty acids that implicate serious health concerns [1]. The shelf life of soybean oil depends upon the oxidative stability of soybean oil as determined by its fatty acid composition. Linolenic acid is the most vulnerable while oleic acid is the least susceptible to oxidation among unsaturated fatty acids as the rate of oxidation of linolenic (C18:3), linoleic (C18:2) and oleic acid (C18:1) are in the ratio of 21.6:10.3:1 [2]. Hence, globally, soybean cultivars with low linolenic and high oleic acid content are being searched and developed to obviate the need of partial hydrogenation [3]. Variability for different fatty acids has been recently reported in Indian soybean varieties [4,5], it was felt pertinent to screen all the advanced breeding lines being tested under AICRPS for fatty acid composition.

All the advanced breeding lines (47) along with three check varieties viz. JS335, JS93-05, Bragg were grown in randomized block design in three replicates using standard agronomic practices in cropping season 2004. Seeds from all the advanced breeding lines were hand harvested on maturity. Days to maturity (DM) of each breeding line were recorded. Mature seeds were dried in a seed drier at 37°C till they became moisture free and the weight of 100 dried seeds was recorded. Oil was extracted from freshly ground soy flour from seeds of single plant using petroleum ether (boiling point 40-60°C) and transesterified using IN sodium methoxide in anhydrous methanol [6]. Fatty acid methyl esters obtained were separated and analysed in gas chromatograph, Shimadzu GC17A, using capillary column SGE BPX70, with length and internal diameter of 30m and 0.32 mm respectively.

A large genotypic variation was observed for 100 seeds weight and days to maturity among advanced breeding lines (Table1). 100 seeds weight ranged from 8.6g for JS97-52 to 16.2g for VLS62 while days to maturity varied from 80days for JS (SH) 99-02 to 103 days for SH40. Table1 also indicates the fatty acid composition of all the advanced breeding lines. Palmitic acid (C16:0) ranged from 6.19% for Himso16-02 to 14.71% for JS97-51 with a mean value of 11.58. Stearic acid (C18:0) ranged from 2.64% for Bragg to 5.87 % for SL710 with a mean value of 4.36. Table1 also shows that oleic acid (C18:1) ranged from 15.55% for SH40 to 48.10 % for NRC-64 with a mean value of 26.68. Seven advanced breeding lines *viz.* NRC64, NRC67, NRC69, SI679, DSb-6-1, JS-98-68, VLS-61 alongwith JS335 exhibited oleic acid more than 35%. Among polyunsaturated fatty acids, linoleic acid (C18:2) ranged from 34.57% for NRC64 to 64.05% for KB279 with a mean value of 50.38 % while linolenic acid (C18:3) ranged from 3.96% for VLS59 to 10.29% for RKS-24 with a mean value of 6.12.

M:P ratio is considered as an indicator of oxidative stability of a vegetable oil. In general, soybean oil possess M:P ratio of 0.5 or less than 0. 5 as compared to 7.0, 2.3, 1.0, 0.5, 0.2 values for olive, Canola, peanut, corn and sunflower oil respectively. In the present investigation, M:P ratio ranged from 0.227 for SH40 to 1.186 for NRC64 (Table 1). A range of M:P ratio from 0.31-1.39 has been reported for released varieties of soybean [4]. In the present study, thirty advanced breeding lines exhibited monounsaturated: polyunsaturated ratio less than 0.5 while ten advanced breeding lines showed between 0.5-0.7 and seven advanced breeding lines *viz.*, NRC64, NRC67, NRC69, SL679, DSb-6-1, JS-98-68, VLS-61 exhibited M:P ratio value above 0.7. The most popular variety JS335 taken

Table 1. Days to maturity, 100 seed weight, percent fatty acid composition, monounsaturated (M): polyunsaturated fatty acids (P) and linoleic (n-6 or ω 6): linolenic acid (n-3 or ω 3) ratio of advanced breeding lines of soybean grown in cropping season 2004 under All India Coordinated Research Project

Entry	DM	100SW	C16:0	C18:0	C18:1	C18:2	C18:3	M:P	n-6:n-3
BAUS-40	84	10.4	10.53	3.95	26.40	52.87	5.9	0.449	8.9
BRAGG	95	10.0	12.59	2.64	23.90	53.78	6.10	0.399	8.8
DS-2101	83	12.1	9.96	4.02	33.50	45.97	6.14	0.642	7.5
DSb-6-1	81	12.1	10.76	3.61	35.71	44.06	5.26	0.724	8.4
Himso-1602	84	13.7	6.19	3.74	23.21	55.66	5.82	0.377	9.6
JS-97-52	95	8.6	12.80	4.79	23.67	52.24	6.27	0.404	8.3
JS-98-63	84	12.4	12.5	3.83	29.75	47.60	5.31	0.562	8.0
JS-98-68	85	11.0	11.88	4.01	35.78	42.82	4.86	0.750	8.8
JS(SH)-99-02	80	12.8	11.48	3.03	26.45	52.87	5.90	0.450	9.0
JS(SH)-99-14	81	13.4	13.56	3.67	26.94	48.19	6.31	0.494	7.6
JS-93-05	81	10.0	12.58	3.68	26.75	50.96	5.38	0.474	9.5
JS-97-51	86	11.5	14.71	3.97	24.38	49.41	6.68	0.434	7.4
JS-335	87	10.4	11.13	3.48	38.51	40.17	5.53	0.842	7.3
KB-249	86	10.4	8.84	3.79	17.78	64.05	5.12	0.257	12.5
MACS-985	86	9.4	11.44	3.95	20.40	57.52	6.53	0.318	8.8
MACS-993	97	10.6	11.46	3.78	21.44	56.95	6.66	0.337	8.9
MACS-998	96	10.8	12.52	4.15	21.04	53.67	6.42	0.350	8.4
MACS-1010	95	10.2	10.92	4.05	19.73	57.87	6.92	0.304	8.4
MAUS-158	85	11.4	12.69	4.07	26.17	49.37	6.34	0.469	7.8
MAUS161	86	11.7	12.37	4.07	30.30	47.81	5.34	0.570	9.0
MAUG-162	85	12.9	13.10	3.63	25.88	50.43	6.94	0.451	7.3
MAUS-187	84	9.9	10.61	3.54	30.61	49.22	6.16	0.552	8.0
MRSB-34	95	11.2	11.29	3.23	25.49	52.71	6.62	0.429	7.9
NRC-64	85	12.5	8.48	2.85	48.10	34.57	5.24	1.186	5.8
NRC-65	83	12.0	13.17	3.84	20.68	55.61	6.69	0.331	8.3
NRC-66	83	12.7	11.67	3.19	30.91	47.73	5.99	0.575	8.0
NRC67	88	13.8	10.51	3.84	40.27	38.43	5.12	0.924	7.5
NRC-68	81	14.3	11.39	4.03	30.32	48.69	4.49	0.570	10.8
NRC-69	84	10.8	11.59	3.31	35.95	42.48	5.92	0.742	7.2
PS-1374	95	10.7	11.61	4.37	23.91	51.17	8.64	0.399	5.9
PS-1385	85	13.1	10.74	4.03	20.55	58.19	5.66	0.321	10.3
PS-1392	85	12.3	13.07	4.14	20.94	55.02	6.30	0.341	8.7
PS-1394	84	14.2	10.16	3.98	23.62	55.31	5.96	0.385	9.3
RKS-21	85	9.8	13.40	4.07	20.41	53.37	8.12	0.331	6.6
RKS-24	87	10.7	13.55	3.92	18.94	51.65	10.29	0.305	5.0
RSC-14	87	11.1	11.58	3.66	28.43	48.44	6.88	0.513	7.0
RKS-15	86	10.2	12.18	3.46	29.03	48.39	6.26	0.531	7.7
RKS-18	86	10.3	12.16	3.78	26.81	49.68	6.04	0.481	8.2
SH-40	103	12.5	12.28	4.00	15.55	60.76	7.48	0.227	8.1
SL-679	84	10.3	9.70	3.15	38.85	40.73	7.00	0.813	5.8
SL-682	81	12.6	12.35	4.08	19.39	56.51	7.39	0.303	7.6
SL-710	88	12.4	12.28	5.87	21.32	52.11	5.43	0.370	9.6
SL-(E)-20	81	14.1	11.69	5.10	27.25	46.30	6.87	0.512	6.7
SL-688	91	12.3	11.26	4.10	27.58	49.68	6.16	0.493	8.1
TS-38	83	14.6	11.23	2.95	24.76	53.53	7.00	0.409	7.6
TS-40	83	13.7	10.99	3.53	25.36	51.27	6.92	0.435	7.4
VLS-59	85	13.3	12.16	3.26	33.06	47.26	3.96	0.645	11.9
VLS-60	84	14.6	11.56	4.00	30.31	48.76	5.07	0.563	9.6
VLS-61	82	13.7	11.27	3.85	35.80	44.23	5.27	0.723	8.4
VLS-62	84	16.2	11.53	4.25	24.55	53.03	5.62	0.418	9.4

*Values given are mean of triplicate samples

as a check exhibited M:P ratio value as 0.843. Table1 also indicates n-6:n-3 ratio that varied from 5.01 for RKS24 to 12.50 for KB249 i.e. n-6/n-3 ratio in all advanced breeding lines and, was well with in the range of FAO recommendations which is 5-10. Correlation studies indicated a highly significant negative correlations of oleic acid with linoleic acid ($p < .001$) and linolenic acid ($p < .01$). In relation to M:P and n-6/n-3 ratio, oleic acid observed significant positive ($p < .001$) and negative correlation ($p <. 05$) respectively. These results are in conformity with earlier reports [4,7]. Linolenic acid observed significant negative correlation with n-6:n-3, M:P and 100SW. Days to maturity observed significant negative correlation with oleic acid ($p < .05$) while significant positive correlation with linoleic as well as linolenic acid ($p < .05$) which is in conformity with earlier reports in oilseed crops [8].

None of the breeding line possessed linolenic acid below 4% and oleic acid around 60% or more as desired for improved shelf life of soybean oil. Oleic acid in soybean being a quantitatively inherited character, two advanced breeding lines NRC64 and NRC67 which showed comparatively higher oleic acid and VLS59 that exhibited lower linolenic acid can be employed for developing varieties with improved oxidative stability of soybean oil.

References

1. **Lichtenstein A. H., Erkkila A. T., Lamarche B., Schwab U. S., Jalbert S. M. and Ausman M.** 2003. Influence of hydrogenated fat and butter on CVD risk factors remnant like particles, glucose, and insulin, blood pressure and C reactive protein. Atherosclerosis **171**: 97-103.
2. **Fatemi S. H. and Hammond E. G.** 1980. Analysis of oleate, linoleate and linolenate hydroperoxides in oxidized ester mixtures. Lipids **15**: 379-385.
3. **Fehr W. R. and Curtiss C. F.** 2004. Breeding for fatty acid composition of soybean. Proceeding of VII World Soybean Conference held during Feb 29- March at Foz do Iguassu, PR, Brazil, pp 815-21.
4. **Kumar V., Rani A. and Joshi O. P.** 2004. Fatty acid profile of released cultivars of Indian soybean with special reference to identification of comparatively low linolenic and high oleic acid cultivars. Indian J Agri. Sci., **74**: 388-391.
5. **Patil A., Taware S. P. and Raut V. M.** 2004. Quality of Indian soybean [*Glycine max* L. Merrill] varieties in relation to fatty acid composition. Indian J Genet. and Breeding, **64**: 245-246.
6. **Luddy F. E., Barford R. A., Herb S. E. and Magidman P.** 1968. A rapid and quantitative procedure for the preparation of methyl esters of butter oil and other fats. J. Am. Oil Chemists Soc., **15**: 549-552.
7. **Liu K. S., Orthoefer F. and Brown E. A.** 1995. Association of seed size with genotypic variation in the chemical constituents of soybean. J. Am. Oil Chem. Soc., **72**: 189-192.
8. **Rani A., Kumar V., Hussain S. M. and Joshi O. P.** 2005. Association of linolenicand oleic acid content with seed size and maturity. J. Oilseeds Res., **22**: 136-140.