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SHORT COMMUNICATION

EFFECT OF PHOTOPERIOD ON FATTY ACID COMPOSITION OF OIL IN SOYBEAN GENOTYPES

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Eight selected soybean genotypes were grown in ambient and extended photoperiod (17 h). Genotypes showed variation in photosensitivity in terms of days to flower and days to maturity. Photo-insensitive genotypes did not exhibit significant changes in fatty acids under extended photoperiod. However, four soybean genotypes, which exhibited photosensitivity both in terms of days to flower and days to maturity, exhibited an increase in oleic acid content and decrease in linolenic acid content. Therefore, photosensitivity in terms of days to flowering appeared to influence the fatty acid composition of soybean.

Key words: **Fatty acid composition, photoperiod, soybean oil**

Soybean [*Glycine max* (L) Merr.] oil is the world's leading vegetable oil, contributing 28% of the total worldwide production of vegetable oil. However, poor oxidative stability of soybean oil is of great concern. Partial hydrogenation carried out at industrial level to enhance the oxidative stability of soybean oil results in the formation *trans* fatty acids about which medical fraternity has raised serious health concerns (Willet and Ascherio 1994, Lichtenstein *et al.* 2003). Oil from conventional soybean cultivars contains 11% palmitic acid (C16:0), 4% stearic acid (C18:0), 23 % oleic acid (C18:1), 53% linoleic acid (C18:2) and 7 % linolenic acid (C18:3) (Fehr *et al.* 1992). Linolenic acid, is considered as the main culprit for poor shelf life of soybean oil because the rate of oxidation of linolenic acid, linoleic acid and oleic acid are in the ratio of 21.6:10.3:1 (Fatemi and Hammond 1980). On the other hand, oleic acid being less susceptible to oxidation imparts oxidative stability to soybean oil. Therefore, globally, soybean cultivars with low linolenic and high oleic acid content are being searched and developed (Ross *et al,* 2000, Rahman *et al.* 2001, Fehr 2004). Furthermore, fatty acid composition of soybean has been reported to be influenced by growing location (Maestri *et al.* 1998, Kumar *et al.* 2003). Though, Madhya Pradesh (central region) is the epicentre of soybean cultivation in India, the crop has recently made inroads into new geographical locations with varying photoperiod. Soybean is a photosensitive short day plant and it requires a critical period of less than 14 h of day length to transit from vegetative to flowering phase. Soybean sensitivity to photoperiod in terms of flowering in soybean has been reported earlier (Sinclair and Hinson 1992, Bhatia *et al.* 2003). However, the information on the influence of photoperiod on fatty acid composition in soybean is not available. Present investigation was undertaken with the objective to study the changes in fatty acid composition of soybean genotypes under extended photoperiod.

A large number of germplasm lines were screened for photoperiod sensitivity in terms of days to flower and maturity in the fields of National Research Centre for Soybean. Of these eight germplasm lines *viz.* MACS 330, EC 325097, EC 33897, EC 34101, EC 325118, EC 325100, EC 251402, EC 325114 with varying sensitivity for the photoperiod were selected for this study. These

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eight genotypes were grown in the field under ambient and extended photoperiod (17 h) at Indore (22 °N) in the cropping season 2003. Extended photoperiod was created by hanging 40 watt incandescent bulb at a height of 3 feet above the crop canopy and the bulbs were connected to an automatic timer. Days to 50% flowering and maturity of different genotypes under ambient and extended photoperiod were recorded. Mature seeds of different genotypes grown under ambient and extended photoperiod were analysed for different fatty acids. The seeds from single plant were crushed. Oil was extracted from freshly ground seed material using petroleum ether (boiling point 40-60^{0}C) and transesterified in methanol with 1N sodium methoxide as catalyst following the procedure of Luddy *et al*. (1968). Fatty acid methyl esters (FAMEs) were separated and analyzed in gas chromatograph (Shimadzu GC 17A) using polyethylene glycol packed SGE BP20 capillary column, with length and diameter of 30 meter and 0.32 millimeter, respectively. Oven temperature of the gas chromatograph was programmed at 140°C for 3.6 min, subsequently increased to 170°C at the rate of 13.5°C per minute and maintained for 3.8 min and finally increased to 182°C at the rate of 5°C per minute for best resolution of methyl esters. The temperature of flame ionization detector (FID) and injector were maintained at 240°C. Nitrogen, the carrier gas used, was maintained at a flow rate of 15 ml/min. The peaks for fatty acid methyl esters were identified by comparing the retention times with those of standard methyl esters (procured from Sigma-Aldrich). Data given in Table 2 for different fatty acids are means of triplicate samples.

Table 1 shows the sensitivity of genotypes *viz*. MACS 330, EC 325097, EC 33897, EC 34101, EC 325118, EC 325100, EC 251402, EC 325114 to photoperiod in terms of days to flower and maturity. MACS 330, EC 325097, EC 33897, EC 34101 were observed to be photo-insensitive in terms of days to flower as there were no significant differences in days to flower under normal and extended photoperiod while EC 325118, EC 325100, EC 251402, EC 325114 were observed to be photosensitive in terms of days to flower as well as days to maturity. EC 325114 and EC 251402 were highly photosensitive in terms of days to flower as under extended photoperiod these genotypes exhibited delay in flowering for 15 and 13 days, respectively. MACS 330 was the only genotype found to be photoinsensitive in terms of days to flower as well as days to maturity. Whereas genotypes EC 325097, EC 333897, EC 34101, which were found to be insensitive in terms of days to flower showed sensitivity in terms of days to maturity.

Table 2 shows the genotypic variation in fatty acid composition of selected germplasm lines under ambient

Table 1. Changes in days to flower and days to maturity under extended photoperiod in selected soybean germplasm lines

Genotype	Ambient conditions		Extended photoperiod		Lateness days	
	DF	DM	DF	DM	Flowering	Maturity
MACS 330	30	70	30	70	0	0
EC 325097	28	70	28	78	0	8
EC 333897	26	71	26	89	0	18
EC 34101	29	73	30	91	1	18
EC 325118	29	71	32	80	3	9
EC 325100	27	72	35	95	8	23
EC 251402	26	73	39	99	13	26
EC 325114	27	74	42	99	15	25

DF -days to flower, DM-days to maturity

Table 2. Per cent fatty acid composition of selected soybean germplasm lines under normal and extended photoperiod

Genotype	% Fatty Acid									
	C16:0		C18:0		C18:1		C18:2		C18:3	
	A	E	A	E	A	E	A	E	A	E
MACS 330	11.01	11.29	2.54	2.94	36.35	39.5	41.02	39.8	7.08	6.64
EC 325097	11.5	11.27	3.26	3.0	17.6	17.3	59.06	59.3	8.48	8.60
EC 333897	10.0	9.74	2.85	3.05	22.37	24.5	56.99	55.9	6.79	6.20
EC 34101	12.21	12.0	3.23	2.81	15.5	18.2	59.23	56.2	10.6	10.2
EC 325118	10.26	8.83	2.76	2.62	35.16	55.64	43.74	27.76	7.01	5.15
EC 325100	11.32	10.71	3.35	3.95	17.48	25.20	59.06	52.55	7.69	5.95
EC 251402	10.89	10.25	3.03	4.06	20.91	25.55	57.03	53.09	7.32	6.12
EC 325114	11.58	10.78	3.77	4.99	17.43	28.69	57.77	45.45	8.35	5.8
LSD (p=.05)	0.88		0.54		3.64		3.60		0.68	

A= ambient conditions with natural photoperiod, E= extended photoperiod (17 h)

and extended photoperiod. Genotypes differed in their fatty acid composition under ambient and extended photoperiod. Under ambient condition low variability was observed for saturated fatty acids *viz.* palmitic (C16:0) and stearic acid (C18:0). Monounsaturated fatty acid *i.e.* oleic acid (C18:1) ranged from 15.50 for EC 34101 to 36.35 for MACS 330. With regard to polyunsaturated fatty acids, linoleic acid ranged from 41.02 for MACS 330 to 59.23 for EC 34101, while linolenic acid ranged from 6.79 for EC 333897 to 10.6 for EC 34101. Under extended photoperiod as compared to ambient conditions, no significant differences for different fatty acids, saturated (C16:0, C18:0) as well as unsaturated fatty acids (C18:1, C18:2, C18:3), were observed in the genotypes MACS 330, EC 325097, EC 33897, EC 34101 which did not exhibit delay in flowering, under extended photoperiod (photo-insensitive). Under extended photoperiod, changes in different fatty acids were observed in four genotypes *viz.* EC 325118, EC 325100, EC 251402 and EC 325114. A significant decline was observed for palmitic acid (C16:0) in the genotype EC 325118, while significant increase for stearic acid (C18:0) was observed in three sensitive soybean genotypes *viz.* EC 325100, EC 251402 and EC 325114. With regard to unsaturated fatty acids, an increase in oleic acid (monounsaturated fatty acid) content to the magnitude of 58.25, 44.16, 22.19, 64.6% was observed in EC 325118, EC 325100, EC 251402 and EC 325114 respectively. Above four genotypes also exhibited a decline in linoleic acid to the magnitude of 36.53, 11.02, 6.91 and 21.33% and linolenic acid to the magnitude of 26.53, 22.63, 16.39 and 30.53, respectively.

Our results suggests that photosensitivity in terms of flowering has more pronounced effect on fatty acid composition of germplasm lines than photosensitivity in terms of days to maturity.

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