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EVALUATION OF QUALITY CHARACTERISTICS DURING DEVELOPMENTAL STAGES FOR GREEN POD CONSUMPTION AMONG SOME OF THE RELEASED CULTIVARS OF INDIAN SOYBEAN

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Introduction

Soybean has been endowed with epithet 'functional food of the century' as beyond traditional basic nutrition viz. high protein, PUFA rich oil, vitamins, minerals, it contains biological ingredients like isoflavones that prevent the risk of dreaded diseases like breast cancer, osteoporosis, cardiovascular ailments, kidney stones and help in beating the menopausal blues¹. Soybean has existed in India as a marginal food plant in some regions of Himalayas since ages² but still it doesn't appear as a common item in Indian cuisine. There are couple of constraints that hinder the promotion of soy-based foods. The prime deterrent among them is the off-flavour associated with various soy-based foods to which Indian populace is not accustomed to. However, at green pod stage, a reproductive growth stage between R6 and R7, the seeds possess low beany flavour because of the low level of lipoxygenases isozymes³. The green pods of soybean are also rich in protein, cholesterol-free fat, phosphorus, iron, thiamine, riboflavin and vitamin E^{4,5}. These immature pods also possess lower level of trypsin inhibitor, the

antinutritional factor that affect protein digestibility, which imparts higher protein efficiency ratio to them⁶. Thus consumption of green pods of soybean much like that of green pea, french bean, green chick pea possess great potential for popularization among Indian masses. The varieties of soybean for consumption at green pod stage need to have special quality characteristics like larger average seed size, green appearance, low bitter/off-flavour, tender texture and high protein value on the fresh weight basis⁷. These desirable quality characteristics have been termed as vegetable-type characters and the varieties of soybean developed for this purpose are known as vegetable soybean. The consumption of soybean at green pod stage is still a concept to be developed in India. The soybean varieties released in India are grown for its mature grain and have not yet been evaluated for above-mentioned vegetable-type quality characters. The present investigation was undertaken among five released varieties of soybean with an aim to identify the suitable stage of picking for green pod consumption and evaluate them

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in terms of quality requirements for vegetable purpose viz. average seed size (expressed as average seed weight in milligrams), percent moisture and protein content for vegetable purpose.

Materials and Methods

Five varieties viz. NRC37, Shilajeet, Punjab1, Hardee, Harit Soya were sown on 2nd July 2001 in the fields of National Research Centre for Soybean, Indian Council of Agricultural Research, Indore. Plants of each variety were tagged at the time of flowering. Developing pods from each variety were picked after 30, 35, 40, 45 and 50 days after flowering with an interval of five days. Percent moisture and dry matter were determined in the shelled out seeds from these freshly picked developing pods by oven dry method. Crude protein content was determined in the freshly picked samples by standard micro-Kjeldahl method and the conversion factor applied for nitrogen into protein was 5.71 as recommended for soybean.

Results and Discussion

Among the varieties under study, the maximum average seed size attained differed and the stage of maximum average seed size was reached at different days after flowering. The maximum average seed size attained in NRC 37, Shilajeet, Punjab-1, Hardee, Harit Soya at 45, 50, 55, 60 days after flowering showed values viz. 270, 430, 320, 375, 590 mg respectively (Table I). The rate of dry matter accumulation also varied in different varieties. The dry matter varied from 10 mg in Hardee to 32 mg in Harit Soya and Shilajeet at 30 DAF. NRC 37 accumulated dry matter very fast and reached the complete

seed fill stage (when there is no further dry matter accumulation) at 45 DAF. Hardee was sluggish dry matter accumulator and reached the complete seed fill stage at 55 DAF. However, maximum dry matter was accumulated by Harit Soya (190 mg) followed by Shilajeet (168 mg), Punjab-1 (130mg) and NRC 37 (100mg) at complete seed fill stage (Table I).

Percent protein on fresh weight basis as observed from 30 DAF to complete seed fill stage in the varieties NRC 37, Shilajeet, Punjab -1, Hardee, Harit Soya were in the range of 13.0 - 15.7, 6.2 - 15.6, 5.9 - 17.5, 3.5 - 13.0, 5.3 - 12.5 respectively (Table II). Maximum protein content on fresh weight basis at 30 DAF was shown by NRC 37 (13.0) and minimum was shown by Hardee (3.5) while at complete seed fill stage, maximum and minimum protein content on fresh weight basis was observed in Punjab - 1 (17.5) and Harit Soya (13.0) respectively. On dry matter basis, the percent protein content from 30 DAF to complete seed fill stage in the varieties NRC 37, Shilajeet, Punjab -1, Hardee, Harit Soya was found in the range of 32.0 - 37.8, 28.0 - 36.4, 26.0 - 40.1, 23.0 - 39.5 and 25.0 - 38.0 respectively. On dry matter basis, the maximum and minimum protein content at 30 DAF was shown by NRC 37 and Hardee respectively while at complete seed fill stage maximum and minimum protein content was shown by Punjab - 1 and Shilajeet respectively.

The green colour of the pods and seeds at the picking stage in tandem with maximum average seed size (on fresh weight basis) is a major desirable quality requirement for consumption of green pods of soybean⁷. The stage of maximum seed size attained did

synchronize with green colour still retained in pods and seeds in varieties NRC 37 and Punjab 1 respectively (Table I). Hence, the stage of 45 DAF was found to be suitable for picking of green pods for consumption in the varieties NRC 37 and Punjab - 1 respectively. In case of Shilajeet and Jarit Soya, though the maximum average seed size had reached in 50 days after flowering, the colour of pods changed to yellow-green/brown, an undesirable character for consumption of green pods. Hence, in these varieties, suitable stage for picking green pods was at 45 days after flowering when the colour of the seeds and pods was still green and the average seed size values were second highest (Table I). In Hardeee, maximum average seed size reached in 55 DAF but at this stage the pods and seeds changed to yellow-green. Hence, the suitable stage for picking up of green pods for consumption was identified to be 50 DAF in Hardee. Maximum average seed size at suitable stage identified for picking for the varieties under study was found to be the highest in

Harit Soya followed by Hardee and Shilajeet, though Hardee attained the suitable stage for picking five days later than the other varieties under study.

Percent moisture at suitable stages of piking identified for NRC 37, Shilajeet, Punjab-1, Hardee, Harit Soya at 45, 45, 50 45 DAF was found to be 61.86, 56.72, 68.50, 70.28 and 70.20 respectively (Table I). Hence, at suitable stage of picking, maximum percent moisture was observed in case of Hardee and Harit Soya while minimum in Shilajeet.

Among the various varieties under study, maximum percent protein content on fresh weight basis at respective suitable stages identified for picking was observed in Shilajeet (15.8) and NRC 37 (15.7) while minimum was observed in Harit Soya (10.5) (Table II). Percent protein content on dry matter basis observed in NRC 37, Shilajeet, Punjab-1, Hardee, Harit Soya at respective identified stages for picking was 37.8, 36.0, 33.0, 39.0 and 31.9 respectively (Table II).

TABLE II
Percent Protein Content of Five Varieties During Developmental Stages

Variety	Percent Protein					
	30 DAF	35 DAF	40 DAF	45 DAF	50 DAF	55 DAF
NRC 37	13.0 (32.0)	13.7 (34.0)	15.6 (36.4)	15.7 (37.8)	16.0 (38.0)	-
Shilajeet	6.2 (28.0)	10.9 (32.0)	11.2 (34.0)	15.8 (36.0)	15.6 (36.4)	-
Punjab - 1	5.9 (26.0)	7.6 (32.0)	8.7 (28.0)	13.5 (33.0)	17.5 (40.1)	-
Hardee	3.5 (23.0)	7.5 (24.8)	7.5 (25.8)	9.2 (38.4)	12.8 (39.0)	13.0 (39.5)
Harit Soya	5.3 (25.0)	8.4 (27.0)	9.6 (29.0)	10.5 (31.9)	12.5 (38.0)	-

* Values in parenthesis indicate percent protein content on dry weight basis

TABLE I
Average Fresh Weight, Average Dry Weight, Dry Matter Accumulation and Colour Characteristic of Beans at Various Stages of Development in Five Released Varieties of Soybean

Variety	DAF	Average seed weight (mg)	Dry Matter %	Moisure %	Colour	
					Pod	Seed
NRC 37	30	62 (25)	40.32	59.68	Green	Green
	35	125 (39)	31.20	68.80	Green	Green
	40	220 (89)	40.45	59.55	Green	Green
	45*	270 (103)	38.14	61.86	Green	Green
	50	240 (100)	41.66	58.34	Yellow-Green	Yellow-Green
Shilajeet	30	148 (32)	21.62	78.38	Green	Green
	35	264 (81)	30.68	69.32	Green	Green
	40	251 (88)	35.05	64.95	Green	Green
	45*	335 (145)	43.28	56.72	Green	Green
	50	430 (168)	39.00	61.00	Yellow-Green	Yellow-Green
Punjab-1	30	122 (28)	22.90	77.10	Green	Green
	35	219 (69)	31.50	68.50	Green	Green
	40	325 (85)	26.15	73.85	Green	Green
	45*	320 (101)	31.50	68.50	Green	Green
	50	240 (130)	54.17	45.83	Yellow-Green	Yellow-Green
Hardee	30	69 (10)	14.49	85.51	Green	Green
	35	120 (36)	30.00	70.00	Green	Green
	40	244 (71)	29.09	70.91	Green	Green
	45	300 (83)	27.66	72.34	Green	Green
	50*	370 (110)	29.72	70.28	Green	Green
	55	375 (157)	41.86	58.14	Yellow-Green	Yellow-Green
Harit Soya	30	153 (32)	20.90	79.10	Green	Green
	35	243 (74)	30.45	69.55	Green	Green
	40	284 (102)	35.90	64.10	Green	Green
	45*	520 (155)	29.80	70.20	Green	Green
	50	590 (190)	32.20	67.80	Brown	Green

* Suitable stage for picking stage; the values in the parenthesis indicate average seed weight on dry weight basis

Summary and Conclusion

Conclusively, the suitable stage for picking green pods was 45 DAF for NRC 37, Punjab - 1, Harit Soya and Shilajeet while it was five days later in the case of Hardee. At suitable stage identified for consumption of green pods, Shilajeet and NRC 37 had recorded maximum protein content on fresh weight basis while maximum average seed size was observed in Harit Soya followed by Hardee and Shilajeet, though, Hardee reached the suitable stage of picking five days later than Shilajeet. Thus, in view of days taken for reaching suitable stage of picking green pods, maximum average seed size and protein content (on fresh weight basis) at the identified suitable stage of picking, Shilajeet was found to possess more suitable characteristics for green pod consumption in comparison to other varieties. Harit Soya did possess maximum average seed size and

acceptable appearance of seed green colour and characteristics even after 50 DAF, for consumption at green pod stage, but it had much lower protein value than other varieties at suitable stage of picking. Thus Shilajeet may be suggested as suitable for consumption as vegetable from both nutritional as well as other acceptable attributes.

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