DRY MATTER ACCUMULATION PATTERN IN SOYBEAN POD AND ITS RELATIONSHIP WITH POD SHATTERING

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SUMMARY

The pattern of dry matter accumulation in soybean pod and its relationship with pod shattering was studied using ten soybean genotypes that differed in the extent of pod shattering during three different seasons (*kharif* 98, *Rabi*/summer 99 and *Kharif* 99). Dry matter accumulation in pod and seed increased continuously up to physiological maturity, whereas dry matter of pod shell increased up to 40 days after anthesis and reduced afterwards. Dry matter accumulation in pod and seeds was negatively correlated with pod shattering. The partitioning efficiency of dry matter from pod shell to seed was higher in the pod shattering resistant varieties than the pod shattering susceptible varieties.

Key words : **Pod, pod shattering, soybean**

INTRODUCTION

Pod shattering is a major problem in soybean. However, information on physiological causes of shattering and attributes related to this process is limiting. In soybean, pod is the primary sink for photosynthates and consequently accumulation of dry matter in pod is an important process. The amount of dry matter produced in pod is an excellent indicator of over all utilisation efficiency of resources. Physiological changes in developing pod would help to understand the physiological reasons for pod shattering. While process of dry matter accumulation in pod and seed has been well documented by earlier researchers (Egli and Leggett 1973, Egli 1975, Thorne, 1979, Zweifel *et al.* 1978 and Gent 1983), but its relationship with pod shattering characteristics has not been elucidated. Therefore the present investigation was undertaken.

MATERIALS AND METHODS

Ten soybean varieties differing in pod shattering (PS) behaviour were considered for the study. The experiment was laid out in a Randomised Block Design with three replications during the *Kharif* 1988 (K'98), *Rabi*/summer 1999 (R/S'99) and *Kharif* 1999 (K'99) seasons. The experiment was conducted at research field of University of Agricultural Sciences, Dharwad (Karnataka) that is between 15°20' N and 75°7' E with the altitude of 678 meter above mean sea level. For each genotype 60-70 flowers were tagged on the second and third day of flower initiation. Ten pods selected randomly from each genotype were detached at 10, 20, 30, 40 days after anthesis (DAA) and at physiological maturity (PM). The pods were air dried at room temperature, seed and pod shell separated and weighed. Partitioning efficiency is calculated as the ratio of seed weight to total pod weight and expressed as percentage. Pod shattering was recorded on five plants in each genotype on the seventh day after the maturity. Pod shattering was calculated as a percentage of shattered pods. The angular transformed values were used for correlation analysis.

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RESULTS AND DISCUSSION

A continuous increase in dry matter from 10 DAA to physiological maturity was observed in the present study. Pod weight was highest in PS resistant Himso-1520 whereas, the PS susceptible genotype Black soybean had the lowest pod weight at all the sampling stages (Table1). The genotypes differ significantly for their pod growth characteristics.

Dry weight of pod increased from 10 DAA upto physiological maturity in all the genotypes, the increase being maximum between 20 to 30 DAA (Table 1). These findings are in agreement with those of Egli (1975) who also observed a similar pattern of pod weight increase upto physiological maturity. On the contrary Norman (1963) reported a little loss of dry matter during pod ripening period. Trends of dry matter accumulation in seeds per pod indicate three fold increase from 20 DAA to 30 DAA and increase continuously up to physiological maturity. Norman (1963) and Egli (1975) also reported similar pattern of dry matter accumulation in seed. Dry matter accumulation in pod shell increased up to 40 DAA and reduced thereafter during physiological maturity. The reduction in accumulated dry matter in pod shell may be due to the redistribution of starch, reducing sugar and nitrogenous material to developing seeds as reported by Thorne (1979).

The mean pod shattering performance was significantly less for Bragg (5.18%), Himso-1520 (7.71%) and JS-335 (10.27%) compared to Monetta (83.20%) and Black soybean (81.71%) (Table 1). The pod weight was greater in the *Kharif* seasons, whereas PS was more in the *Rabi*/summer season, due to the favourable environmental conditions. Increased dry matter accumulation in pod was observed is *Kharif* season. However high temperature and low relative humidity during the *Rabi*/summer season provided the favourable climate for pod shattering compared to *kharif* seasons.

The correlation between pod shattering and pod weight at 40 DAA and physiological maturity was consistently negative (Table 2). There was negative correlation of pod shattering with pod weight at all the sampling stages during the K'98. The correlation in the other seasons was not always significant. Seed weight per pod at 40 DAA and physiological maturity expressed consistent negative correlation with pod shattering. This indicated that genotypes with higher pod and seed weight might have

Table 1. Dry matter accumulation in pod, pod shell, seed weight per pod and pod shattering (%) of soybean varieties*

Variety	Pod weight per pod (mg) Days after anthesis					Pod shell weigh (mg) Days after anthesis				Seed weight per pod (mg) Days after anthesis				Pod shattering (%)
	10	20	30	40	PM	20	30	40	PM	20	30	40	PM	
Bragg	59.22	139.6	343.6	449.5	469.5	72.33	115.3	157.5	147.5	67.33	228.3	292.0	322.0	5.18
Monetta	54.11	181.0	375.2	418.0	426.8	153.5	184.7	196.1	170.6	27.44	190.4	221.8	256.2	83.20
JS-335	62.89	180.1	312.2	430.1	445.7	129.6	134.7	156.6	139.5	50.44	177.4	273.4	306.2	10.27
MACS-58	38.11	168.5	344.0	402.4	413.4	93.78	230.6	189.6	148.3	74.78	113.3	212.7	265.1	25.83
JS80-21	32.44	187.7	341.7	413.7	435.8	143.7	179.2	148.0	153.3	44.00	162.5	265.7	282.5	55.04
Himso 1520	65.89	229.2	397.4	525.1	544.1	170.4	196.6	234.2	195.8	58.78	200.7	290.8	348.2	7.71
KHSb-2	39.78	147.4	237.8	375.3	390.1	104.5	159.0	167.7	137.0	42.89	114.8	207.5	253.1	21.33
Hardee	35.56	140.1	241.7	323.3	341.6	88.4	115.7	127.3	116.3	53.89	126.0	196.0	225.3	31.92
Gaurav	34.11	147.1	254.0	356.2	370.8	73.8	112.1	159.7	129.5	73.22	141.8	196.4	241.3	28.13
Black soybean	22.67	130.3	193.0	243.8	269.3	76.5	79.4	100.1	106.1	53.78	113.5	143.7	163.2	81.71
GM	44.47	165.1	307.7	393.7	410.7	110.7	150.7	163.7	144.4	54.65	156.9	230.1	266.3	35.0
CV(%)	6.07	3.36	4.37	1.66	1.46	6.92	9.30	7.72	2.35	10.23	2.44	5.31	1.90	6.38
CD at 5%	4.36	8.98	21.74	10.59	9.73	13.00	22.66	20.45	5.49	9.04	6.20	19.75	8.19	3.61
CD at 1 %	5.76	11.86	28.74	14.00	12.86	17.19	29.96	27.03	7.26	11.94	8.19	26.11	10.83	4.77

*Mean of *kharif* 98,99 *rabi*/summer 99.

Table 2. Correlation of pod shattering with the different pod characters in different seasons and pooled analysis

Character	Seasons			Pooled
	Kharif 98	Rabi/ summer 99	Kharif 99	
Pod weight at				
10 DAA	-0.656**	-0.239	-0.449**	-0.622**
20 DAA	-0.407**	0.182	-0.212	-0.263
30 DAA	-0.397**	-0.146	-0.218	-0.288
40 DAA	-0.561**	-0.576**	-0.538**	-0.584**
PM	-0.555**	-0.598**	-0.544**	-0.593**
Pod shell weight at				
20 DAA	-0.270	0.480**	-0.145	0.047
30 DAA	-0.264	0.108	-0.055	0.113
40 DAA	-0.451**	-0.256	-0.222	0.366*
PM	-0.246	-0.259	-0.190	0.247
Seed weight at				
20 DAA	-0.135	-0.775**	-0.127	-0.428**
30 DAA	-0.333	-0.321	-0.282	-0.334
40 DAA	-0.423**	-0.701**	-0.577**	-0.633**
PM	-0.638**	-0.704	-0.695**	-0.726**

*,**:Significant at 5and 1per cent level respectively

Tabie 3. Partitioning efficiency of accumulated dry matter from pod shell to seeds of soybean varieties over the seasons.

Variety	Partitioning efficiency			
	20DAA	30DAA	40DAA	PM
Bragg	47.94	67.86	65.03	68.56
Monetta	14.97	51.43	53.63	60.02
JS-335	27.65	57.64	63.95	68.64
MACS-58	44.39	33.30	52.73	64.11
JS 80-21	23.74	48.23	63.85	64.45
Himso-1520	30.67	54.36	55.91	64.04
KHsb-2	29.66	43.16	55.47	64.76
Hardee	44.10	54.02	61.01	65.95
Gaurav	53.00	57.15	55.62	64.74
Black soybean	41.63	60.09	59.73	60.57
GM	35.78	52.76	58.71	60.58
CV(%)	11.34	6.74	4.03	1.06
CD at 5%	4.59	4.01	2.68	0.77
Correlation with pod shattering	-0.163	0.026	-0.056	-0.689**

**Significant at 1 per cent level

pod shattering resistance. The present findings were supported by the observation of high pod shattering during *Rabi*/summer with low dry matter accumulation in pod and seed. Tiwari and Bhatnagar (1991) and Vimala Devi (1993) reported the negative association of 100 seed weight with pod shattering. Inconsistent association was observed between pod shell development and pod shattering indicating that, it may not be the factor responsible for the expression of pod shattering and was season specific. Partitioning efficiency of the genotypes from total pod dry matter into seed is presented in Table-3. PS resistant genotype viz. Bragg and JS-335 has higher partitioning efficiency during PM, as compared to others that is supported with the negative correlation with pod shattering at physiological maturity. So, the genotype, which had higher pod dry matter and efficient partitioning towards the seed in later stage of pod development might be having lower pod shattering expression.

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