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Investigation on seed development and maturation in Hedge Lucerne (*Desmanthus virgatus* L. Willd)

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Abstract : Studies were carried out in *Desmanthus virgatus* cv. TNDV 1 to assess the duration of pod and seed development with physical, physiological and biochemical indices in two crops *viz.* crop raised from seed and the crop raised after first cutting of seed crop (after 180 days). The study revealed that physical characters of pod and seed and physiological and biochemical characters of seed vary with maturation and attained physiological maturity 30-35 days after anthesis (DAA) in both the crops. But delayed harvest lead to total loss of seed due to shattering. The seeds remained hard (100%) during developmental period and were germinable only after acid scarification for 15 minutes @ 200 ml per kg of seed.

Key words : Desmanthus, Seed, Development and maturation, Pod and seed characters, Shattering.

Introduction

Knowledge on the pattern of seed development and maturation is highly warranted in seed production of any cultivated crop irrespective of agricultural, horticultural , forage or sylvicultural species. Delouche (1973) defined seed maturation as the morphological, physiological and functional changes that occur during the time of fertilization until the matured seeds are ready for harvest. Ovacharov and Kizilova (1966) opined that timely harvest of crop ensure good seed yield associated with viability, vigour and field performance.

Physiological maturity of the seeds is widely defined as the stage at which the seed attains its maximum dry weight and related physical characters (length, breadth and size) which was correlated by the maximization of viability and vigour and can be visualized by changes in colour of either pod or seed or both. Physiological maturation of the seed is often identified or defined based on various physical, physiological and visual characters. Such studies are rare in *Desmanthus* which is having continuous flowering sequence and shattering habit, that insist on fixation of stage of harvest with symptoms for collection of quality seed. Hence studies were made with *Desmanthus* cv. TNDV 1.

Materials and Methods

The seed crop of *Desmanthus virgatus* cv. TNDV 1 served as the base material. Sufficient number of flowers were tagged at 50 per cent flowering, just prior to anthesis and the pods were collected at five days interval up to shattering (35-40 days after anthesis). The crop was given a cut at 180 days after sowing and in the crop after first cut also the flowers were tagged and the above procedure was followed. At each stage of collection in both crops observations were made on pod characters *viz.* length, breadth, fresh weight, dry weight, colour change; seed characters *viz.* fresh weight, dry weight, moisture content (ISTA, 1999), protein content (Ali-khan and Youngs, 1973); seed quality characters *viz.* germination (ISTA, 1999), drymatter production and vigour index (Abdul-Baki and Anderson, 1973). The results were subjected

Table 1. Changes in pod characteristics during development and maturation *of Desmanthus virgatus*

Maturation stages (DAA) (S)	Length (cm)		Breadth (cm)		Fresh weight (mg)		Dry weight (mg)		Colour changes
	C1	C2	C1	C2	C1	C2	C1	C2	
5	1.5	1.5	1.0	1.0	2	2	0	1	-
10	5.1	5.0	3.2	3.1	49	49	16	16	-
15	5.3	5.4	3.9	3.9	74	74	32	32	Green
20	5.7	5.7	4.0	4.0	95	95	50	50	Green
25	5.3	5.6	4.0	4.0	110	111	72	72	Reddish brown
30	5.9	5.9	4.0	4.0	121	120	94	91	Brown
35	5.8	5.8	4.0	4.0	113	130	92	106	Brown
40	5.8	5.8	4.0	4.0	102	122	87	105	Shattering

	C	S	CxS	C	S	CxS	C	S	CxS	C	S	CxS
CD(P=0.05)	NS	0.270	NS	NS	0.147	NS	0.002	0.004	0.006	0.001	0.003	0.004

C1 - first crop; C2 - crop after first cut
DAA - Days after anthesis

Table 2. Changes in seed characteristics during development and maturation of *Destnanthus virgatus*

Maturation stages (DAA) (S)	Fresh weight 100 seeds-1 (mg)		Dry weight 100 seeds-1 (mg)		Moisture content (%)		Protein content (%)		Colour changes
	C1	C2	C1	C2	C1	C2	C1	C2	
5	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-
15	30.0	22.0	10.0	7.0	67.0	69.1	-	-	Light green
20	42.0	34.0	22.0	16.0	47.5	53.5	23.5	25.8	Green
25	46.0	43.0	34.0	25.0	26.1	39.5	22.9	24.1	Yellowish brown
30	50.0	49.0	40.0	25.0	20.9	28.9	21.7	23.9	Brown
35	46.0	51.0	37.0	40.0	17.8	20.7	20.2	22.4	Brown
40	44.0	49.0	37.0	40.0	14.7	18.9	20.0	21.1	Dark brown

	C	S	CxS	C	S	CxS	C	S	CxS	C	S	CxS
CD(P=0.05)	0.011	0.005	0.015	0.006	0.003	0.008	0.595	0.267	0.841	0.135	0.064	0.191

C1 - first crop; C2 - crop after first cut DAA - Days after anthesis

Table 3. Changes in seed and seedling quality characteristics during development and maturation *of Desmanthus virgatus*

Maturation stages (DAA) (S)	Germination (%)		Drymatter production (mg 10 seedlings^{-1})		Vigour index	
	C1	C2	C1	C2	C1	C2
5	-	-	-	-	-	-
10	-	-	-	-	-	-
15	-	-	-	-	-	-
20	19 (25.62)	28 (32.40)	19.5	20.0	157	102
25	34 (36.01)	38 (39.42)	21.0	22.0	252	258
30	52 (46.21)	72(60.41)	23.5	23.0	486	357
35	86 (67.79)	92 (73.65)	22.5	24.5	443	496
40	84 (66.42)	88 (69.93)	21.5	23.5	416	458

	C	S	CxS	C	S	CxS	C	S	CxS
CD(P=0.05)	NS	2.507	3.545	0.554	1.176	NS	7376	15.647	22.128

Cl- first crop; C2 - crop after first cut
DAA - Days after anthesis
(Figures in parantheses indicate arc sine transformed values)

to statistical analysis as suggested by Panse and Sukhatme (1967) and tabulated.

Results and Discussion

Highly significant variations were observed between the crops, among the developmental stages and also for their interaction, for all the evaluated pod, seed and seed quality characters except few characters (Table 1, 2 & 3).

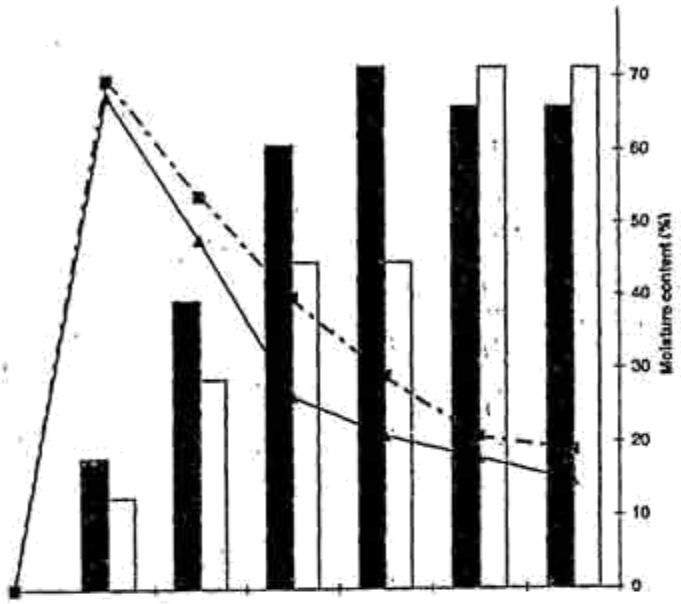
Pod characters

In the present study, the pod length was in increasing order from 5 DAA (1.5 cm) to 30 DAA (5.9 cm). Pod breadth increased from (5 DAA) 1.0 mm to a maximum of 4.0 mm at 20 DAA. Fresh weight of the pods increased steadily from 2 mg to 122 mg and the dry weight also increased gradually from 0.5 mg to 99 mg from 5 DAA to 35 DAA. This increase in weight was steady and linear with increase in days to maturation and was supported by developmental variations observed in the morphological features of the pod as its length and breadth (Table 1) as revealed by Jayabarathi (1982) in soybean and Ushamythili (1982) in lab lab. Pods were initially green (20 DAA) and changed to brown colour at 30-35 DAA.

Seed characters

Seed fresh weight increased gradually and attained maximum at 30 DAA (50 mg) and thereafter got reduced, whereas the seed dry weight was maximum at 25 DAA (39 mg) and maintained the same till harvest. Between the crops

Fig.1. Changes in the seed moisture content and dry weight during development and maturation in *Desmanthus virgatus*



the first crop recorded maximum value at 30 DAA (40 mg) and crop after first cut at 35 DAA (40 mg). Mayer (1973) reported the loss of water with accumulation of drymatter as the characteristic feature of seed development. In line with this view, in the present study, the moisture content decreased from 68.1 to 16.8 per cent with periods of maturation (15 DAA to 40 DAA) (Fig.l). The decrease in moisture content with advancement of maturation stage might be due to desiccation and dehydration of seed as reported by Jayabarathi (1982). This also could be due to the replacement of osmotic material by starch and other large molecules with low hydration capacity (Milthorpe and Mooby, 1979). Sale and Campbell (1989) found protein accumulation occurred continuously until maturity has been reached in the developing seeds. But in present study, protein content was maximum at 20 DAA (24.6 per cent) and decreased to 21 and 20 per cent, respectively in first crop and crop after first cut at 30 and 35 DAA, as the important metabolic steps during the early phases of seed development, were rapid and completed- earlier than deposition of carbohydrates and fats in the maturing seeds (Arul Prabhu, 1998). Similar decrease of protein content with maturation was also reported by Vishnurammethi (1996) in *Clitoria ternatea.* In the interaction effect, the crop after first cut recorded maximum value (21.1 per cent) at 40 DAA. In the present study the seed colour was greenish upto 20 DAA and turned to reddish brown with advancement in maturation and shiny luster was also added to the seed with the attainment of physiological maturity. Carlson (1973) expressed that the photosynthates moved into the developing ovule through extensive network of vascular tissue located throughout the outer integument. The vascular system of

the integument was destroyed as the seed matures, which coincided with the turning of seed coat colour.

Seed and seedling quality characteristics

The seeds of the present study, irrespective of crop and stages of maturation failed to germinate indicating the development of hard seeds even during maturation. But the seeds were germinable after treating with commercial sulphuric acid for 15 minutes. The treated seeds initiated germination to a tune of 34 per cent at 20 DAA in first crop and to 28 per cent in crop after first cut. Thereafter there was a gradual and steady increase and it reached the peak value of 90 and 92 per cent, respectively in first crop and crop after first cut at 30 and 35 DAA. Similar results were reported by Sabir-Ahamed (1989) in soybean and Arulprabhu (1998) in pole bean. Dry matter production varied significantly and reached maximum at 35 DAA (23.5 mg), which was on par with 30 DAA (23.3 mg). Here the dry matter accumulation was in coincidence with the accumulation of higher quantum of fresh and dry weight of pod and seed and per cent germination: Thereafter, the dry matter production decreased slightly due to the development of inbuilt mechanism to withstand drying of seed, which involves the disorganization of cell organelles in the few days after physiological maturity (Mathews, 1973). Like other quality parameters vigour index values increased gradually over the periods and reached maximum at 35 DAA (470), which coincided with the maximum dry weight accumulation and higher germination. Between the crops, seeds from first crop recorded higher value (195) than seeds from crop after first cut (186).

In the present study variation was also observed in accumulation of food reserves and expression of seed quality characters between the first crop raised from the seed and the crop raised after first cut (Table 2 & 3), which was higher in the crop raised after cut and lower in first crop raised from seed. In the first crop (February sowing) maturation study was carried out during May-June where the temperature was higher (33.5°C). But the crop grown after the cut was given cut during August where the maturation study was carried out during October-November, the winter months (30.4°C). The existing variation between the crops on duration of maturation as 30 and 35 DAA, respectively, in first crop and crop after first cut might be due to the variation in the atmospheric temperature during maturation. Loch and Butler (1987) reported that increasing temperature reduced the duration of seed filling stage. Hence the variation in the present study might be due to cutting and seasonal effect of this perennial fodder crop. Thus the study revealed that in *Desmanthus,* seeds attained physiological maturity at 30 DAA and 35 DAA in the first crop and the crop after first cut respectively, which was indicated by turning of pod to brown colour and the seed to shiny brown from green. The delayed harvest of pod for five days lead to complete shattering of seeds in both crops. Hence the pods of *Desmanthus virgatus* should be harvested at 30-35 DAA, the stage at which it attain physiological maturation.

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