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Quantitative and qualitative changes in seed quality during seed development and maturation in pea *(Pisum sativum* L.)

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Abstract : Full germination capacity and vigour cannot be attained until seeds reach physiological maturity. This study was designed to assess the quantitative changes in seed quality of pea *(Pisum sativum* L.) during development and maturation and to fix the physiological maturity stage. A field trial was conducted with pea cv. 'Bonneville' and seeds were harvested in 7 days interval from the starting of flowering and assessed for quality parameters in laboratory. Seed dry weight attains maximum at 49 DAA which is being concluded as the physiological maturity stage. Seed moisture content at this stage was 30%. The onset of ability to germinate occured at 21 DAA. Maximum seedling dry weight and vigour index occurred at 49 DAA. Electrical conductivity and free amino acid reduced as maturation of seed advanced but the seed protein content found to be increased.

Key words : Pisum sativum **L,** *Physiological maturity, Seed quality.*

Introduction

Pea (*Pisum sativum* L.) is an important legume crop grown for green peas. Research conducted elsewhere has revealed that 10-20 per cent of yield could be increased by use of quality seed alone (Chandigiram *et al.* 1987). Quality seed not only provides the bridge between the breeder and farmer but also acts as a catalyst in the adoption of better management practices and production technology. To produce high quality seed, the seed crop must attain maximum dry weight and full germination capacity at the stage of physiological maturity (Tekrony *et al.* 1981). Harrington (1972) reported that after physiological maturity, nutrients no longer flow to the seed from the mother plant. A number of factors such as moisture content, fresh weight of seed, dry weight of seed (Delouche and Bastin, 1973) were used to assess the physiological maturity. This study was designed to assess the changes in seed quality during development and maturation and to fix the stage of physiological maturity to facilitate harvesting.

Materials and Methods

The pea cv. 'Bonnevilla' was sown at Nanjanadu farm, Horticultural Research Station. Ooty during November 1998. The soil of the experimental field was well drained and sandy loam type. The plot size was 4 x 5 m^2 with plants spaced 10 x 40 cm. N, P and K was applied at the rate of 80:100:90 kg ha^{-1} as basal and followed by application of N alone at the rate of 80 kg ha^{-1} at 20 days after sowing. All other recommended package of practices were carried out. A randomized complete block design was used with four replications.

Sufficient number of flowers were tagged with the information of date of flowering. Enough pods were harvested at seven days interval and assessed for various physical, physiological and biochemical characters. Fresh weight of pod and seed were recorded. The fresh pods and seeds removed immediately from the pods were dried in hot air oven maintained at 103 ± 3° C for 16 hrs. From these materials. dry weight of pod and seed and moisture content of pod and seed were determined. Remaining seeds were then sun dried until seed moisture content reached approximately 8%. Standard germination test was conducted in sand medium and incubated in the germination room maintained at 25 ± 2°C temperature and 90 ± 3 per cent

Table 1. Effect of development stages on physical properties of pod and seed in pea (*Pisum sativum* L.)

Days after anthesis	Fresh weight of pod (g10 pods^{-1})	Dry weight of pod (g 10 pods^{-1})	Fresh weight of seed (g 10 seed^{-1})	Dry weight of seed (g 10 seed^{-1})
7	10.2	1.6	2.7	0.6
14	33.5	30	4.1	1.0
21	74.5	11.2	6.0	3.1
28	112.6	26.4	6.8	3.6
35	146.4	53.5	7.0	4.4
42	176.5	76.7	7.2	4.7
49	210.3	99.5	7.4	4.
56	208.5	98.4	7.1	4.6
CD (P=0.05)	11.66	9.22	0.72	0.26

Table 2. Effect of development stages on physiological and biochemical properties of seed in pea (*Pisum sativum* L.)

Days after anthesis	Root length (cm)	Shoot length (cm)	Dry matter production (mg 10 seedlings^{-1})	Vigour index	Electrical conductivity (dSm^{-1})	Free amino acids (µg)
7	-	-	-	-	2.260	90.6
14	-	-	-	-	1.968	86.5
21	7.6	5.3	149	255	1.840	80.4
28	8.8	7.4	173	786	1.665	78.5
35	10.2	8.6	186	1340	1.562	77.6
42	11.4	9.7	196	1756	1.390	74.3
49	15.6	13.4	234	2764	1.258	72.9
56	14.9	12.6	228	2558	1.245	70.6
CD (P=0.05)	1.29	1.14	1.62	21.60	0.07	0.96

RH. Seedlings were counted and evaluated on 7th day according to ISTA rules (ISTA, 1996). From the standard germination test, 10 randomly selected normal seedlings were measured for root and shoot length and vigour index was calculated using the formula prescribed by Abdul-Baki and Anderson (1973). Then these 10 seedlings were kept in hot air oven maintained at 85°C for 16 hrs. and seedling dry matter production was estimated. Electrical conductivity of seed leachate (Presley, 1958), protein content (Ali-Khan and Youngs, 1973) and free amino acid (Ching and Ching, 1964) were also measured.

Results and Discussion

Fresh and dry weight of pod and seed increased as the development stages progressed. But it is reversed in case of moisture content of pod and seed (Table 1). The quantum of moisture content might be associated with the

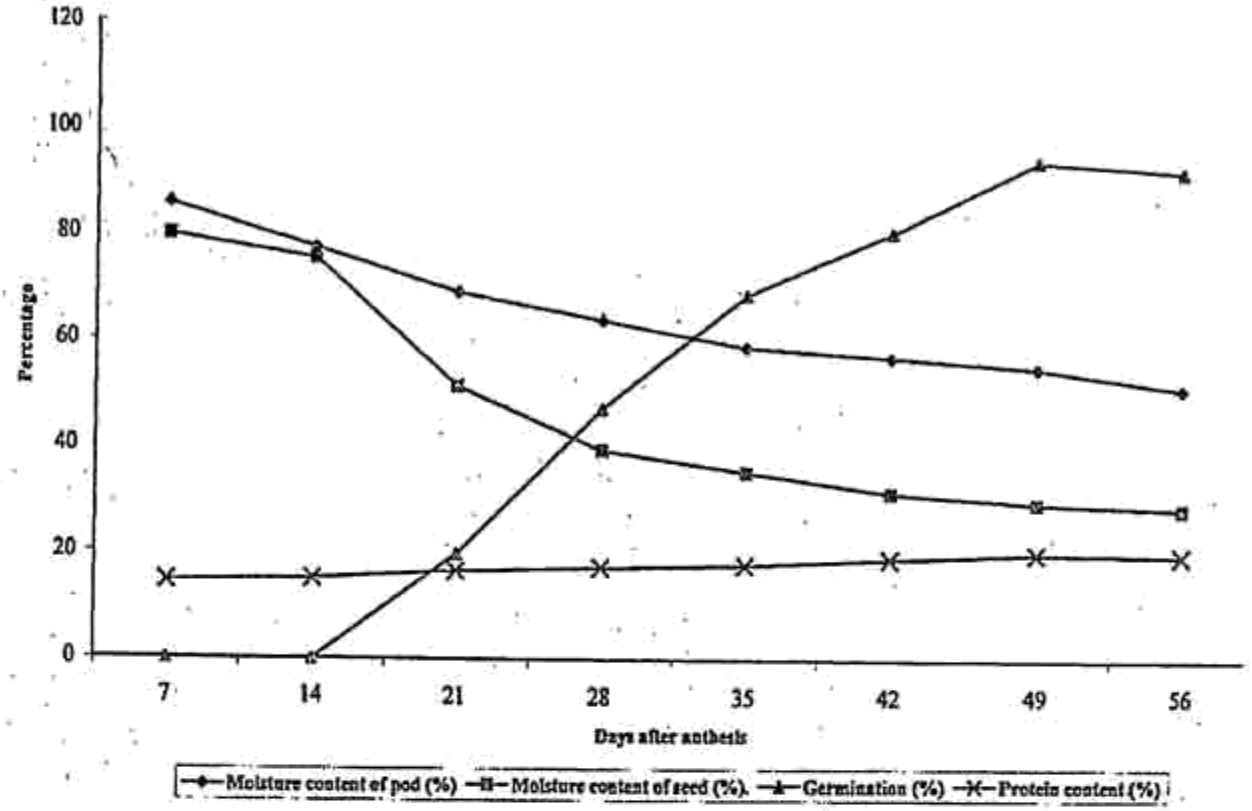

Fig.1. Effect of development stages on moisture content, germination and protein content of seed in pea (*Pisum sativum* L.)

deposition of reserve materials as revealed by the increase in dry weight throughout the developing period (Rao and Rao, 1975). Seed attains the maximum dry weight at 49 DAA. As stated by Tekrony. *et al.* (1981), the stage at which the seed attains maximum dry weight is the stage of physiological maturity. This has been supported by the results of investigations in soybean (Tekrony *et al.* 1980) and wheat (Rasyad *et al.* 1990).

Once the seed attains maximum dry weight, the disruption of vascular connection between fruit and mother plant is severed (Denuff and Rachidian, 1988). This may be the reason for the reduction in fresh and dry weight of pod after 49 DAA. The reduction in dry weight of seed after 49 DAA might be due to oxidation and volatilization of chemical entities (Harrington, 1972).

The onset of germinability occurred at 21 DAA. Even though the seeds posses the ability to germinate in the earlier stages of development, it was increasing with increase in maturity of seed and attains maximum germinability at 49 DAA (Fig 1). The root and shoot length, dry matter production and vigour index of seedlings were also maximum at 49 DAA and declined thereafter. This follows the hypothesis that seeds attains maximum quality at the end of physiological maturity and thereafter viability and vigour decline (Harrington, 1972).

The electrical conductivity of seed leachate and free amino acids get declined as development stages advanced. More electrical conductivity at earlier stages might be due to poor integrity of cell membrane and immature nature of embryos. The rate of accumulation of protein was much higher during early stages of development and reaches maximum at 49 DAA. This result was

supported by Lott *et al.* (1984). The present study, concluded that pea seed reached maximum physiological and biochemical characters at 49 DAA.

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