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PATTERN OF SEED DEVELOPMENT AND MATURATION IN OKRA (*ABELMOSCHUS ESCULENTUS* L. MOENCH)

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ABSTRACT

An experiment was conducted to study the seed development pattern in okra. Eight genotype of okra were grown in replicated trial in RBD at C Block farm, Kalyani under B.C.K.V., Mohanpur. Flowers of selected plant were tagged and later capsule developed from it was harvested at six stages of development for recording morphological, physiological and biochemical data to decipher physiological maturity of seed. These parameters indicated seed attained maximum dry mater accumulation, soluble protein and germination potential at 35 DAA all the genotype with slight variation in pattern of development. Hence, the present finding revealed that 35 days after anthesis is suitable stage for harvesting of capsule in okra during pre *kharif* for quality seed harvest.

Key words : Okra, Physiological Maturity, Stages of development.

Introduction

Okra (*Abelmoschus esculentus* L. Moench) is widely cultivated vegetable crop belongs to *Malvaceae* family. It has a prominent position among vegetable fruits due to its high nutritive and medicinal value, ease of cultivation, wider adaptability to varying weathers, year-round cultivation, high yield (Reddy *et al*., 2012). For cultivation of crop, production and good quality seed is prerequisite. One of the most critical aspects that influence the seed quality is the stage of development and maturation for harvest. According to Delouche (1971), maturation is a series of metabolic and physiological changes in seeds that culminate in the accumulation of the maximum amount of dry matter. Harringaton (1972) termed this stage as physiological maturity of seed. According to Shaw and Loomis (1950), physiological maturity denotes the stage of development when the seed reaches its maximum dry weight and marks the end of the seed filling period. The general pattern of seed development and maturation are followed by seeds of all crop species, although time required for each phase varies within and among species and growing environments. Harvesting of capsule at ideal stage of development not only aims at preserving the seed vigour and viability but also minimize the chance of field deterioration. Whereas, seed quality is at its peak at the stage of physiological maturity therefore, being able to identify this stage of development based on morphological, physiological and biochemical indices of seed and capsules that will aids a seed grower in optimizing field practices to maximize the seed quality and yield. Keeping all the things under consideration, present study was undertaken to identify the stage of physiological maturity for quality seed harvest in okra.

Materials and Methods

Eight genotype of okra were evaluated in a randomized block design (RBD) with three replications each at C-Block Research Farm, Kalyani under Bidhan Chandra Krishi Vishwavidyalaya (B.C.K.V.), Mohanpur during pre *kharif* 2022. Recommended cultural and agronomic practices were undertaken to maintain healthy crop stand. The flowers were tagged and capsule of the tagged flowers were harvested at six different stage of

development *i.e.*, 10, 20, 25, 30, 35 and 40 days after anthesis (DAA). Capsules harvested at each stages of development were used for recoding morphological parameters and then extracted seed were used for estimation of physiological and biochemical parameters.

The following data were recorded on morphological parameters of capsule at each stage of its development:

a. **Capsule Diameter (cm) :** Same capsule as taken for measuring capsule length were taken for capsule diameter. The diameter of capsule was measured at middle portion with a vernier calliper. The average diameter of capsule was calculated.

b. **Capsule Fresh Weight (g) :** The fresh weight of ten capsules from randomly selected plant was taken with the help of electronic balance and the average was calculated.

c. **Capsule Dry Weight (g) :** The capsules used for calculation of fresh weight were sun dried till no further loss in weight, and then average dry weight of capsules recorded.

The seed extracted from selected capsule was used for estimation of following physiological parameters at each stage of development of all selected genotype:

a. **100 Seed Weight (g) :** A random sample from pure seed fraction was used for estimating 100 seed weight. Eight replicates of 100 seed were weighted before and after drying for each seed of each harvesting stage. The mean value was expressed in grams

b. **Seed Moisture Content (%) :** Moisture content of seed was determined by the low constant temperature oven method i.e. 103°C for 17 hours as per ISTA (2019). Five gram of okra seed were coarse grinded in two replicates and put in aluminium container. The weight was recorded for empty container and with seed before drying. After drying seeds were immediately removed and kept in desiccators for cooling. Seeds were re-weighed and the difference was used to compute the seed moisture content using the following formula;

$$MC\ (\%) = \frac{M_2 - M_3}{M_2 - M_1} \times 100$$

Where, M_1 = Weight of the container (g)

M_2 = Weight of the container plus seed before drying (g).

M_3 = Weight of the container plus seed after drying (g)

c. **Germination (%) :** Eight replicates of 50 seeds for each treatment were used for germination test through between paper methods as prescribed by ISTA (2019). In this method, seeds were placed between two layer of wet germination paper which was then rolled and wrapped in a sheet of wax paper so as to keep minimum surface evaporation. Then, it was kept in germinator in upright position at 25 ± 1^{0}C and 95 percent relative humidity. At 21 days, germinated seedlings were evaluated for calculation of germination (%).

$$\text{Germination}\ (\%) = \frac{Number\ of\ Normal\ seedling}{Total\ number\ of\ seed} \times 100$$

Percentage germination data were converted into angular transformed value and then statistical analysis was performed for interpretation of result.

Biochemical analysis was also conducted on extracted seed for estimation of following:

a. **Estimation of Soluble protein :** One gm seed sample were grind with 0.1M phosphate buffer (pH 7.0) in pre cooled morter and pestle. The homogenate was centrifuged at 10000rpm at 4^{0}C for 30 minutes. Then supernatant was collected for estimation of protein by Lowery method (1951).

b. **Estimation of Alpha Amylase :** One gram of seed homogenized with 4.0ml of ice cold 10 mM calcium chloride solutions and then it was centrifuged at 10000g at 4^{0}C for 30 minutes. The supernatant was used as enzyme source. The alpha amylase activity was measured as µmole maltose produced per minute per g sample. (Sadashivam and Manickam, 2021).

c. **Estimation of Peroxidase :** One gram of seed was ground in a pre-cooled mortar and pestle with 0.1M phosphate buffer (pH 7.0). After that, the homogenate was centrifuged at 10000rpm at 4^{0}C for 30 minutes. In a fresh tube, supernatant was collected for estimation of peroxidase activity as rate of increase in absorbance per unit time per gram of seed (Sadashivam and Manickam, 2021).

The replicated data were collected for all genotype at each developmental stage for above mentioned parameters. The statistical design factorial RBD was

used for analysis of data collected data using SPSS software.

Results and Discussion

The present experiment was undertaken to identify stage of physiological maturity of okra seed as defined by Harrington (1972) based on specific morphological indices of capsule and seed in addition to physiological and biochemical indices of seed during seed development and maturation. Considering these, significant variability in morphological parameters of capsule such as length, diameter, fresh weight and dry weight was observed with advancement of development and maturation. Graphical presentation showed, initially it was increased rapidly with its maximum value at specific stages influenced by genotype. The most rapid early capsule growth, over 70%, was recorded till 20 DAA (Fig. 1). This indicates the rapid cell division and elongation phases of development. Capsule length and diameter was recorded maximum at 25 DAA in all genotype except in Pusa bhindi-5 for capsule diameter which was recorded highest at 30 DAA. Fresh weight and dry weight of capsule showed maximum performance at 20 DAA and 35 DAA, respectively. Toward maturation, these values showed decreasing trend during the dehydration stage and ultimately get stabilized as depicted in graph. The decline in fruit diameter may be linked to the shrinkage of fruits reported by Myint *et al.* (2001). The maximum dry matter accumulation in capsule at specific stages signaled an indication about its physiological maturity which were further examined by evaluating morphological, physiological and biochemical indices of seeds. Morphological indices of seed such as seed size/diameter and 100 seed fresh weight showed increasing trend initially followed by stagnation and finally rapid reduction in weight were recorded which might be due to maturation drying. While 100 seed dry weight was slowly increased at first, then much more rapidly and finally more slowly as the point of maximum dry weight is approached. In this whole process seed moisture content played an important role. At initial stages of development, seed moisture content was observed more than 80 percent in all genotype flowed by reduction slowly, but still it remains relatively high throughout most of the maturation period because water is the vehicle for transferring nutrients from the parent plant to the developing seeds. Later, rapid reduction in moisture content proceeds during the maturation drying phase until hygroscopic equilibrium is attained with the environment. This pattern was showed by all genotype with significant

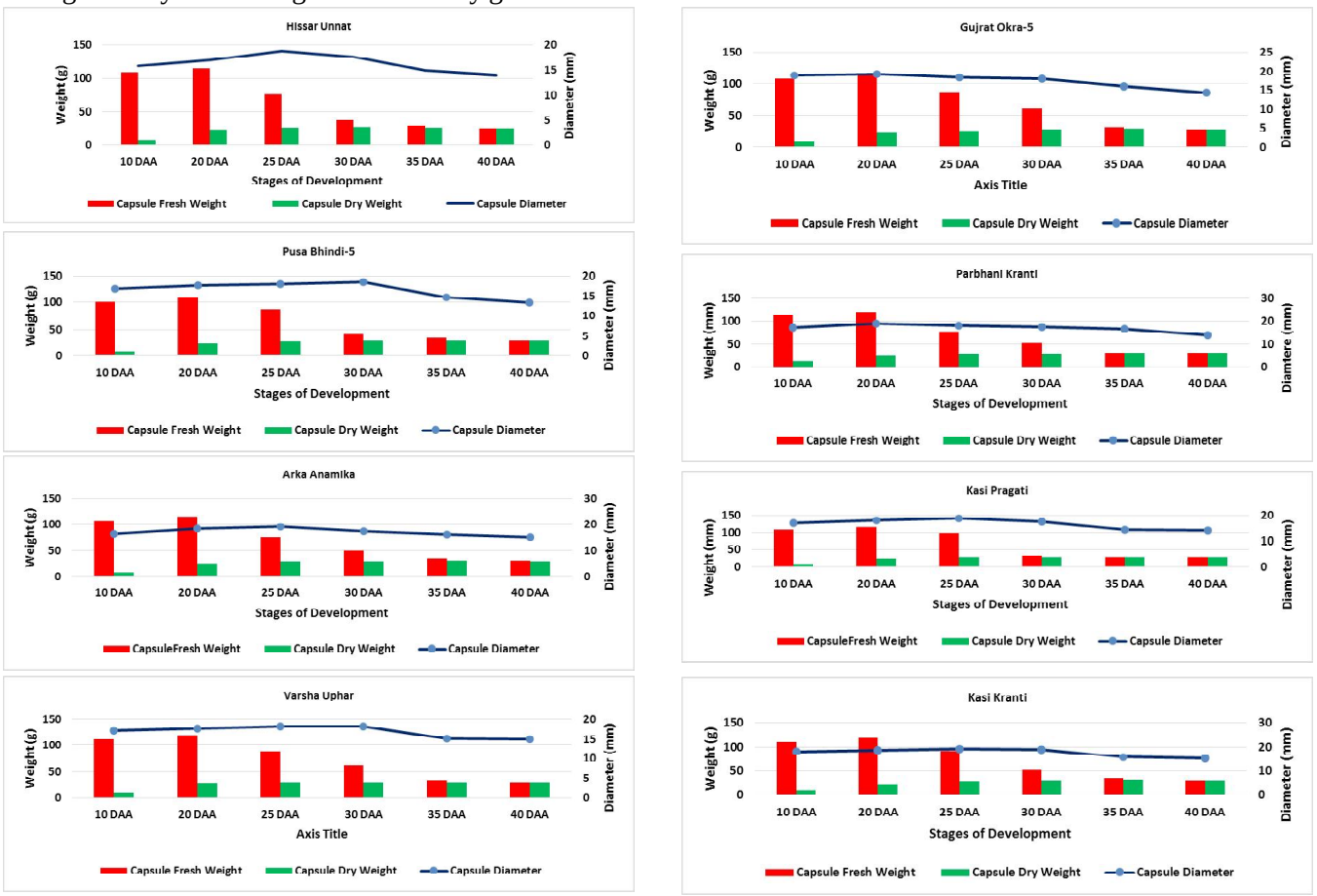

Fig. 1 : Developmental pattern in capsule during its development and maturation in different varieties of Okra.

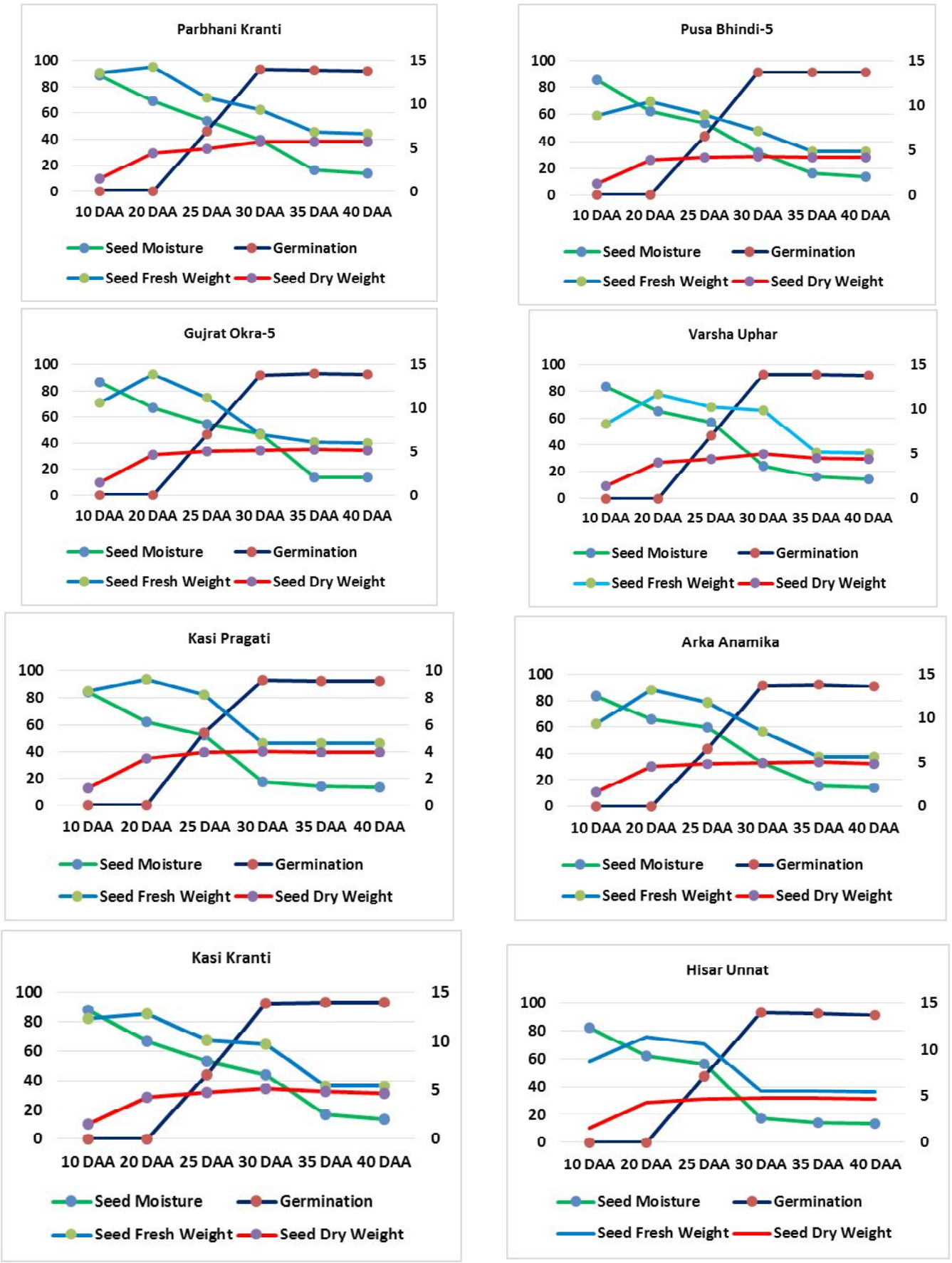

Fig. 2 : Physiological pattern during seed development and maturation in different varieties of Okra.

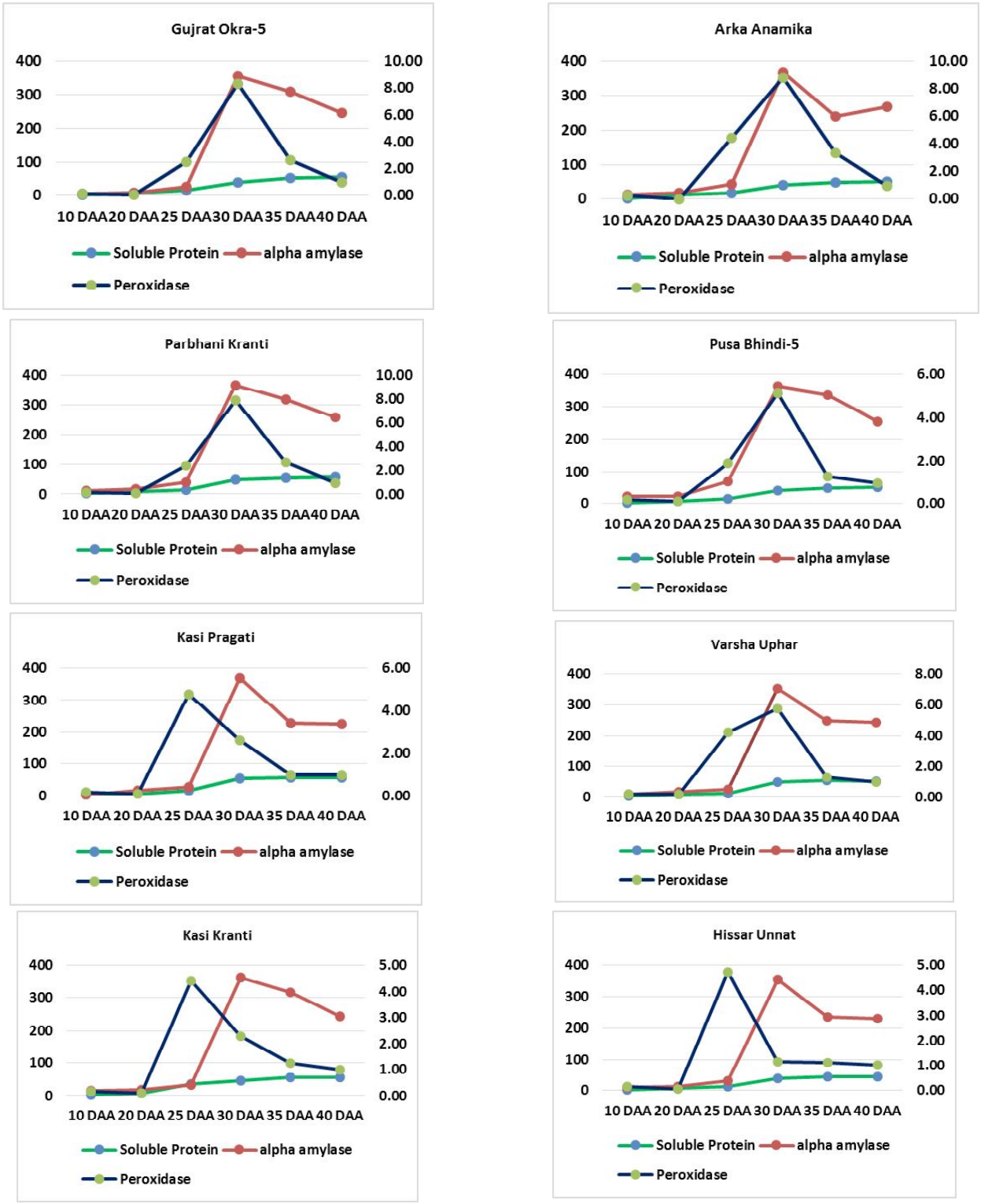

Fig. 3 : Biochemical pattern during seed development and maturation in different varieties of Okra.

variation in magnitude. Similar observation was also recorded by Ellis (2019). Although, the length of time needed for each phase to complete varies within and between species and circumstances; seeds of all crop species follow these broad patterns of seed growth and development. Physiological performance based on seedling characters revealed that seeds started to germinate at 25 DAA and the germination percent significantly increased with increase in maturity up to 35 DAA and non-significant changes were observed at higher developmental stages (Fig. 2). This might because early during development the embryos initially lack sufficient

nutrients to support their continued development to a germinable stage, and also lack the nutrients and stored reserves to support germination and post germination growth (Bewely and Black, 1994). The increasing trend in germination percent during developmental stages and attainment of maximum germination might be related to the accumulation of dry matter in association to decreased seed moisture. The germination at 35 DAA was ranged between 91.67 percent (Pusa Bhindi-5) to 93.00 percent (Kasi Kranti). Similar observations on the trend of increase in germination with progression of maturity were also reported by Demir and Samit (2001) in tomato. Biochemical indices such as soluble protein in seed, amylase and peroxidase activity closely linked with vigour of seed (Henning *et al*., 2010). Pattern of changes in these biochemical indices during developmental stages having great significance for deciphering physiological maturity of seed in association with morphological and physiological indices. It was recorded that similar accumulation pattern of soluble protein in seed during development. However, significance difference in soluble protein content was also recorded among genotype. Initially there was a consistent increase followed by rapid progression in later stage at 30 DAA and then value gets stabilized towards maturity. Maximum soluble protein in seed was estimated in Kasi Pragati (56.71 mg/g seed) at 35 DAA and found at par with value at 40 DAA of same genotype. In another biochemical indices *i.e.* activity of alpha amylase having vital role in seed germination process. In present studies, activity of this enzyme was estimated at different stages of seed development to decipher the pattern of changes during maturation process. It was observed that during initial stage *i.e.* up to 25 DAA, the enzyme activity was recorded very low, which was vigorously activated at 30 DAA (Fig. 3). But, the later stage toward maturity, the activity was further reduced with reduction in seed moisture content. Among all the genotype, Kasi Pragati showed a significant higher activity at 30 DAA. The finding of Ramaya *et al*. (2013) also revealed similar trend of alpha amylase activity during seed development and maturation in onion. The pattern of peroxidase activity during seed development was also widely used to give information about biochemical quality of seed. This enzyme played an important role in seed metabolism, contributing to an increase in defense mechanisms and preventing a loss in quality (Rabadia *et al*., 2006). Here also, significantly variable pattern of activity with stages of seed development was also found. The maximum activity was recorded at 30 DAA (5.243 ΔA minutes^{-1} g^{-1}) followed by 25 DAA (3.669 ΔA minutes^{-1} g^{-1}), 35 DAA (1.182 ΔA minutes^{-1} g^{-1}), 40 DAA (0.974 ΔA minutes^{-1} g^{-1}), 10 DAA (0.164 ΔA minutes^{-1} g^{-1}) and least at 20 DAA (0.088 ΔA minutes^{-1} g^{-1}) (Fig. 3). According to Bailly *et al.* (2004), an increase in the activities of peroxidase parallel to seed development indicated that it played a significant role in combating oxidative condition, and are well connected with the increased deposition of protein and reduced seed moisture content in maturing seed. Similar pattern in the activity of peroxidase were recorded during seed development in several other species (Bailly *et al*., 2004; Montavon and Bortlik, 2004). When we considered all the morphological, physiological indices together we found the maximum dry matter accumulation in seed and capsule in each genotype is coincide with attainment of significant highest germination potential and soluble protein content in seed which was found at 35 DAA in all the genotype. It was also observed that the seed moisture content at this stages of development were 21.99 percent (Hisar Unnat) to 24.34 percent (Kasi Pragati).

Fig. 4 : Capsule of eight genotype (G1-G8) arranged sequentially for each developmental stages.

Conclusion

The finding of the present studied revealed that for quality seed production in okra during pre *kharif*, harvesting of capsule at 35 days after anthesis in the considered genotype is preferred because at this stage seed attained maximum dry matter with soluble seed protein and also showed significantly highest level of physiological performance based on germination. Therefore, based on mean value 35 DAA may be considered as physiological maturity stages in okra.

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