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RESEARCH ARTICLE

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Effect of seed maturity on germination and seedling growth of *Physalis peruviana* (L.)

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ABSTRACT : An experiment was conducted to assess the effect of seed maturity on germination and seedling growth of cape gooseberry (*Physalis peruviana* L.). Seeds extracted from the fruits harvested at three stages of fruit development *i.e.* S_1 - 49 days after fruit set, S_2 - 56 days after fruit set and S_3 - 63 days after fruit set and used for germination test and growth analysis of the seedlings. Results revealed that highest germination (93.86 %) was in the seeds those extracted from 56 days after fruits set (S_2), followed by S_3 - 63 days after fruit set (86.39%), while minimum germination (80.71 %) was observed in the seeds of 49 days maturity (S_1). Seeds extracted from 56 days after fruit set exhibited better seedling growth in terms of higher shoot length, root length, collar thickness, number of leaves and leaf area, however, the results were at par with S_3 treatment. Dry matter accumulation in the seedlings was also highest in the seedling those raised from the seeds extracted at 56 days after fruit set.

KEY WORDS : Germination, *Physalis peruviana* L., Seed maturity, Seedling growth

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INTRODUCTION

The *Physalis peruviana* (L.) of the family Soalanaceae, is native to Peru and Chile (Legge, 1974). It is commonly called as "*Poha'* in Hawaii, 'Golden berry' in South Africa '*Rasbhari'*, '*Makoi'* or '*Tepari'* in India (Gupta and Roy, 1980). *P. peruviana* is a herbaceous, soft wooded erect and somewhat viney shrubs that has ribbed, often purplish spreading branches and nearly opposite on which, velvety heart shaped pointed leaves appears along the stem. Yellow pendulous flowers born in leaf axils which are self-pollinated but the pollination is enhanced by gentle shaking of flowering stems or giving the plants alight spray with water (Mortan, 1987). After the flower falls, the calyx expends, ultimately forming a straw-coloured husk much larger than the fruits encloses. Fruits are climacteric seedy berries (Trinchero *et al.*, 1999). The berry is globose, smooth, glossy, orange-yellow skin and juicy pulp containing numerous very small yellowish seeds. The fruits are eaten fresh and used for preparation of excellent quality of jam for which it is also called the 'Jam fruit of India' (Majumdar, 1979). The edible fruits has complex volatile compounds (Mayorga *et al.*, 2001) and containing high levels of vitamins A, B, C, β-carotene, phosphorus and iron (Hewett, 1993; **S**arkar and Chattopadhyay, 1993) and pectin (Majumdar and Bose, 1979). *P. peruviana* is also a potent medicinal

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plant, widely used in folk medicine as anticancer, antimycobacterial, antipyretic, immunomodulatory and for treating diseases such as malaria, asthma, hepatitis, dermatitis, diuretic (Chiang *et al*., 1992; Pietro, *et al*., 2000 and Wu *et al*., 2005).

P. peruviana is a quick growing short duration crop suitable growing as pure crop or an intercrop in orchards because of its small stature and bushy habit. The crop have wide adoptability of soil and climatic conditions and said to be grown wherever the tomato in cultivation (Morton, 1987). In India, *P. peruviana* has long been grown in home gardens, but commercial production has been on a very small scale and very little information is available on cape gooseberry cultivation under Indian conditions. *P. peruviana* can be propagated through seeds and by vegetative mean *i.e.* cuttings (Morton, 1987). It is commercially raised through seeds (Chattopadhyay, 1996). McCain (1993) also recommended that it is better to propagate *P. peruviana* from seedlings. According to Crawford (2004), the cape gooseberry seeds germinate fast and this is a good prerequisite for seed propagation.

In modern agriculture, uniform seedling establishment is necessary, which needs having high quality seeds (Hadavizadeh and Raymond, 1989). The quality of seed depends on several factors which influence the planting value of seed. Besides crop factors, growing environment affect seed quality during seed formation, and, therefore, have effect on seedling establishment, crop growth and productivity. The high seed quality in terms of viability and vigour are the essential factors which determine the seedling development in the field to get maximum yield besides of high quality. As such, only seed of high quality genetically pure and physiologically sound seeds are is needed to increase the crop productivity. It is matter of concern that every seed should readily germinate and produce a vigorous seedling for ensuring high yield. Among several cultural practices, harvesting of the fruit at right stage of maturity assumes greater importance for obtaining higher quality. Seed maturation is one of the main components of seed quality and a prerequisite for successful germination and emergence, therefore, seed crops should be harvested when quality traits of seed are maximal (Perry, 1982). Seeds harvested at right stage well possess maximum viability and vigour, and seed lots with high vigor show high final emergence compare to seed lots with low vigour (Johnson and Wax, 1981). Seed quality begins to decrease after reaching maximum quality which can occur in delayed harvestings. Keeping in view, present investigation aimed to determine the maturity stage of seed *P. peruviana* for enhanced germination and seedling growth.

EXPERIMENTAL METHODS

In present investigation, *P. peruviana* fruits were obtained from experimental crop established in open field at Main Experiment Station, Department of Horticulture, Narendra Deva University of Agriculture and Technology, Narendra Nagar, Kumarganj, Faizabad (Uttar Pradesh), India during 2005 (latitude 26°47' N, longitude 85°12' E, 113m elevation). The location falls under Indo-Gangatic plains of Eastern Uttar Pradesh, India. This site is characterized by sub-humid and sub-tropical climate observing mean annual rainfall 1190 mm, mainly received during July to September. Under the study, degree of seed maturity treatments were S_1-49 days after fruit set, S_2-56 days after fruit set and S_3-63 days after fruit set. One kg uniformly large size, regularly-shaped and healthy fruits of each maturity grade were collected in the month of January. Seeds of different maturity were extracted from the fruits harvested according to their treatment level by natural fermentation process and after drying seeds were packed in polybags for further germination and seedling growth studies.

Germination test was performed in the first week of July. The experiment was laid out in Complete Randomized Design with 7 replications. In each treatment, 100 seeds were placed between germination papers and then moistened every eight hours. Germination count was started from 5th day and the final germination count was recorded on 15th day. For observations on seedling growth, seed beds of 0.5 x 0.25 m size were prepared in first week of July under naturally ventilated polyhouse using soil and FYM in equal proportion and seeds were sown in the beds at 10 cm line spacing. All the beds were mulched with paddy straw till germination starts. After germination, thinning was done for maintaining the seedling to seedling distance at 5 cm. Other nursery practices adopted were similar for all the treatments. Ten seedlings in each treatment were used for recording data on seedling height, root length, stem diameter, number of leaves per seedling, leaf area and dry matter accumulation of seedlings (dry weight of shoot, root and total seedling dry weight) at 25th day after sowing.

Data recorded durng the course of investigation were statistically analysed as per standard procedure (Panse and Sukhatme, 1985).

EXPERIMENTAL RESULTS AND ANALYSIS

Seed maturity significantly influenced the seed germination percentage of *P. peruviana* (Fig. 1). Highest germination percentage was recorded in the seeds extracted at 56 days after fruit set (S_2), which was found significantly superior than the seeds of 63 days and 49 days maturity. Minimum germination percentage was recorded in the seeds obtained from the fruits harvested 49 days after fruit set. Germination is considered as the end result of a complex and interactive process involving a number of physiological, morphological, environmental and cultural factors. According to Delouche (1980), harvest time is known to be a major factor responsible for physiological maturation level, size and vigour of seed during maturation. Various levels of development including differentiation, maturation, or cell expansion, desiccation and seed drydown are involved prior to the germination and growth phases. Endogenous hormones are often involved with seed development. Seed ABA content commonly increases during development and then declines during later maturation or the drying phase. Generally, seeds with high vigour germinate more rapidly

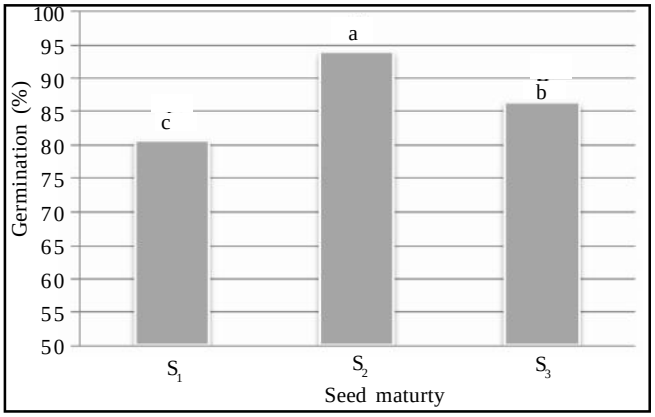

Fig. 1 : Effect of seed maturity on germination (%) in *Physalis peruviana*. S_1=49 days after fruit set, S_2=56 days after fruit set and S_3=63 days after fruit set. Bar with different letters differ significantly at 5 per cent level of significance

Table 1: Effect of seed maturity on shoot length, root length and collar thickness of *Physalis peruviana* seedlings

Treatment	Shoot length (cm)	Root length (cm)	Collar thickness (cm)
S_1	14.21^c	12.83^b	0.25^b
S_2	19.32^a	16.75^a	0.33^a
S_3	17.16^b	14.20^b	0.30^b
CV (%)	6.08	5.33	5.90

S_1 = 49 days after fruit set, S_2 = 56 days after fruit set and S_3 = 63 days after fruit set. Values with different letters within same column differ significantly at 5 % level of significance

Table 2: Effect of seed maturity on number of leaves and leaf area of *Physalis peruviana* seedlings

Treatment	No. of leaves per seedling	Leaf area (cm^2)
S_1	3.72^b	54.45^b
S_2	4.23^a	60.49^a
S_3	4.04^{ab}	58.65^a
CV (%)	5.64	4.24

S_1 = 49 days after fruit set, S_2 = 56 days after fruit set and S_3 = 63 days after fruit set. Values with different letters within same column differ significantly at 5 % level of significance

Table 3 : Effect of growing media on dry matter accumulation in *Physalis peruviana* seedlings

Treatment	Shoot dry weight (mg)	Root dry weight (mg)	Total dry weight (mg)
S_1	46.60^c	7.35^c	53.95^c
S_2	59.62^a	9.42^a	69.04^a
S_3	53.45^b	8.16^b	61.61^b
CV (%)	5.01	5.05	5.00

S_1 = 49 days after fruit set, S_2 = 56 days after fruit set and S_3 = 63 days after fruit set. Values with different letters within same column differ significantly at 5 % level of significance

compared to those with low vigour. In the present study, germination per cent has been evaluated from 5th day on daily basis for 15 days. The test was held on the premise that, seeds harvested at right maturity will result higher germination per cent because that low vigour seeds usually have low germination percentage compared to high vigour seeds. Seed development studies in tomato showed that the maximum seed quality is obtained from fruits harvested when they are red and firm which occurs around 70 days after anthesis (Demir and Ellis, 1992, Valdes and Gray, 1997). Chaudhari *et al.* (1992) also reported that tomato seeds attained maximum quality (germination, germination rate, emergence, resistance to ageing) when they are extracted from the fruit of about 70 days after anthesis.

Data presented in Table 1 revealed that the maturity stage of the seed had significant effect on vegetative growth of *P. Peruviana* seedlings. Maximum shoot length was recorded in the seedlings raised from seeds obtained from 56 days after fruit set, followed by 63 days after fruit set and minimum in the seeds which were extracted at 49 days after fruit set. Root length was also affects by seed maturity stages, with maximum values in seedlings raised from seeds obtained at 56 days after fruit set, followed by 63 days of seed maturity (after fruit set) and minimum in the seedling raised from the seeds extracted from 49 days after fruit set. Collar thickness of the seedlings were also in similar pattern as shoot as well as root length of the seedlings, exhibiting significantly higher collar thickness in the seedlings raised from 56 days of seed maturity, followed by 63 days and 49 days of seed maturity. Minimum collar thickness was measured in the seedlings raised from 49 days of seed maturity.

Number of leaves per seedling was affected by the seed maturity and it was recorded maximum in the seeds harvested at 56 days after fruit set, however, it was found statistically at par with those seeds harvested at 63 days of maturity (Table 2). Number of leaves per seedling in case of 63 days of seed maturity was higher than in seedling raised from 49 days of seed maturity but the results were at par. Maximum leaf area was measured in the seedling raised from seeds of 56 days maturity which was significantly higher than the leaf area in case of 49 days of seed maturity, but statistically at par with the leaf area obtained in the seedlings raised from seeds of 63 days maturity. Better seedling growth in seedlings raised from 56 days seed maturity might be attributed to the higher seed quality and higher food reserves because of right stage of maturity, as the carbohydrates, especially starch represents the major food reserve in most of the seeds. During early germination, mobilization of stored food occurs and once the carbohydrates are mobilized, they may converted into soluble form *i.e.* sucrose, glucose and fructose, that readily transportable to the sites where they are required for growth. According to Demir and Samit (2001), seeds of red-firm tomato fruits harvested at 70 days after anthesis posses the maximum seed quality and seed quality declined in earlier and later harvests. Pandita *et al*. (1996*)* also reported that maximum germination vigour index in tomato occurred when seeds extracted from pink fruit stage.

Dry matter accumulation in the seedlings was influenced by seed maturity stages (Table 3). Results revealed that the seeds extracted at 56 days of maturity exhibited higher dry matter accumulation (shoot dry weight, root dry weight as well as total dry weight of seedlings) which was statistically significant over those obtained in the seedlings raised from 63 days and 49 days of seed maturity. In present study, higher amount of dry matter in the seedlings of 56 days seed maturity is attributed to better seedling growth as observed in present study.

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