

## EFFECT OF GAMMA RADIATION ON THE SEED GERMINATION AND SEEDLING GROWTH OF *CICER ARIETINUM* L.

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The effect of gamma radiation on seed germination and seedling growth of *Cicer arietinum* L. (Chickpea) was studied. The seeds were irradiated with 5, 15, 25, 35, 45, 55, 65 and 75 KR doses of gamma rays. Doses up to 45KR had beneficial effects on seed germination, seedling growth and fresh weight. Increase in radiation, from 55KR, to 75KR resulted in the proportionate reduction in seed germination, root length and shoot length.

**Keywords:** Chickpea; Dose; Effect; Gamma radiation; Germination; Root length; Shoot length.

Chickpea (*Cicer arietinum* L.) is one of the most important pulse crops cultivated in many parts of the country. The seeds are rich in proteins and are also good source of dietary carbohydrates<sup>1</sup>. Gamma rays produce some weak radiotoxins, which in small amounts enhance the endogenous levels of growth, hormones stimulating the seed germination and growth, while in large amounts causes a reduction in the levels of growth hormones<sup>2</sup>.

Many promising results on the effects of gamma radiations on seed germination, seedling growth and yield have been reported<sup>3-7</sup>. In the present study, effect of different doses of gamma radiation on seed germination, seedling growth, fresh weight of seedlings and development of lateral roots in chick pea is reported.

Healthy seeds of *Cicer arietinum* L, were procured from Mahatama Phule Agricultural University, Rahuri, and irradiated with 5, 15, 25, 35, 45, 55, 65 and 75 KR doses of gamma rays at College of Agricultural Biotechnology, Loni and categorised as dose treated seed lots.

The seed lots were labeled as T<sub>0</sub> for control, T<sub>1</sub> irradiated with 5 KR dose, T<sub>2</sub> with 15KR dose and so on, up to T<sub>8</sub> with 75KR dose.

These treated seeds were surface sterilized with 0.1% mercury chloride for 1 min and then washed thrice with sterile distilled water. Twenty seeds from each seed lot were placed on sterilized filter paper in Petri dishes (in three replicates). Seeds kept without dose treatment served as control.

On fourth day, seeds were observed to record the seed germination. Emergence of radicle was considered

as a criterion to consider the seed as germinated. The percent seed germination was calculated. Growth parameters viz., root length and shoot length were noted on 4<sup>th</sup>, 6<sup>th</sup>, 8<sup>th</sup> and 10<sup>th</sup> day, while the number of lateral roots developed and fresh weight of seedlings were noted on 10<sup>th</sup> day.

From the data, average values were calculated and applying 't' test, growth parameters were statistically evaluated at P < 0.05 level.

The results are presented in Table 1-3.

Gamma radiation doses up to 45KR had beneficial effect on seed germination, root length and shoot length, while doses above 55 KR had detrimental effect on seed germination and seedling development. There was a significant reduction in percentage seed germination, root length and shoot length with increase in radiation dose from 55KR to 75KR. Doses at 45, 55, 65 and 75 KR inhibited the development of lateral roots and also reduced the fresh weight of seedlings. Similar observations were reported by Kataria and Singh<sup>2</sup> and Patil *et al.*<sup>6</sup>. Sidris *et al.*<sup>7</sup> reported that the effect was due to the activation and destruction of biological activity of gibberilic acid at lower and higher doses of radiations respectively, while Casarett<sup>1</sup> reported that the reduction in germination percentage was due to radiation damage of embryo and denaturation of DNA and this denatured DNA may be repaired after some time resulting in activation of vital processes involved in germination. Thus, the seeds may be induced for germination and seedling development by lower doses of gamma radiations.

**Table 1.** Effect of radiation on percentage seed germination of *Cicer arietinum* L.

Days after treatment	Control To	Dose amount variable in KR							
		5 T1	15 T2	25 T3	35 T4	45 T5	55 T6	65 T7	75 T8
4	90%	95%	100%*	100%*	100%*	100%*	90%	75%	55%

**Table 2.** Effect of radiation on seedling growth of *Cicer arietinum* L.

Parameter	Days after treatment	Control To	Dose amount variable in KR							
			5 T1	15 T2	25 T3	35 T4	45 T5	55 T6	65 T7	75 T8
Root length	4 <sup>TH</sup>	3.0 ±0.3	3.8 ±0.9*	3.6 ±0.5*	3.5 ±0.8*	3.8 ±0.5*	3.9 ±0.6*	2.8 ±0.4	2.5 ±0.6	2.0 ±0.2
	6 <sup>TH</sup>	4.5 ±0.26	4.6 ±0.9*	4.8 ±0.4*	4.9 ±0.1*	5.0 ±0.2*	5.2 ±0.3*	3.32 ±0.1	2.9 ±0.1	2.5 ±0.1
	8 <sup>TH</sup>	5.8 ±0.25*	6.2 ±0.3*	6.5 ±0.3*	6.8 ±0.3*	6.9 ±0.3*	6.8 ±0.3*	4.1 ±0.2	4.1 ±0.2	4.0 ±0.2
	10 <sup>TH</sup>	6.23 ±0.3*	6.5 ±0.2*	6.8 ±0.3*	6.9 ±0.3*	7.0 ±0.3*	7.5 ±0.3*	4.8 ±0.24	4.6 ±0.21	4.5 ±0.22
Shoot length	4 <sup>TH</sup>	1.0 ±0.5	1.80 ±0.4*	1.95 ±0.1*	2.45 ±0.2*	2.48 ±0.2*	2.80 ±0.4*	0.5 ±0.5	0.4 ±0.2	0.2 ±0.1
	6 <sup>TH</sup>	2.0 ±0.1	2.81 ±0.2*	2.85 ±0.2*	3.25 ±0.1*	3.43 ±0.1*	3.82 ±0.1*	1.52 ±0.7	1.41 ±0.7	1.21 ±0.6
	8 <sup>TH</sup>	3.0 ±0.15	3.80 ±.5*	4.95 ±0.2*	4.45 ±0.2*	4.48 ±0.2*	3.80 ±.5*	2.5 ±.2	2.4 ±.2	2.2 ±.1
	10 <sup>TH</sup>	4.0 ±0.2	4.80 ±0.2*	4.95 ±0.3*	5.45 ±0.5*	5.48 ±0.4*	4.80 ±0.2*	3.5 ±0.5	3.4 ±0.5	3.2 ±0.1

Expressed in terms of mean ± SD. \*significant at P &lt; 0.05

**Table 3.** Effect of radiation on development of lateral roots and fresh weight of *Cicer arietinum* seedlings.

Parameter	Control To	Dose amount variable in KR							
		5 T1	15 T2	25 T3	35 T4	45 T5	55 T6	65 T7	75 T8
Lateral roots (10 <sup>th</sup> day)	+	+	+	+	+	-	-	-	-
Fresh weight (gms) (10 <sup>th</sup> day)	3.11 ±0.14	3.25 ±0.20*	3.62 ±0.13*	3.65 ±0.21*	3.35 ±0.22*	3.01 ±0.24	2.0 ±0.2	1.50 ±0.14	1.25 ±0.21

Lateral roots developed = +, Not developed = -.

Expressed in terms of mean ± SD. \*significant at P < 0.05

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cm across, solitary, rarely in pairs, stalk jointed towards the top. Buds tomentose, elliptic - oblong, Sepals up to 1.5 cm long, linear - oblong. Petals little shorter, narrow, oblong usually notched at the apex, basal gland broad, suborbicular, villous. Ovary glabrous or pilose. Drupe orange-yellow, deeply 2-lobed, smooth.

India. Occasional in fallow fields.

Fl. & Fr. : August-October

Bela, DS : 1014

10. *Maerua oblongifolia* (Forssk.); FBI 1 : 171 : Jafri in Fl. W. Pak. 34 : 15, 1979-*Nieburhia arenaria* DC (Capparaceae).

A large woody glabrous or pubescent climber. Leaves 9 cm, broadly ovate, acute, obtuse or retuse. Corymbs terminal or lateral shoots. Flowers 3 cm long, white. Calyx tube dilated upwards, half the length of the limb. Berry 4-16 long., deeply constricted between the seeds. Seeds smooth, brown colour.

Ceylon, India. Rare - upon the shrubs, on ridges and hillocks.

Fl. & Fr. March - June.

Jaitpur, DS : 1231

11. *Pedaliium murex* L., Syst. Nat. Ed. 10. 1123, 1759: FBI. 4 : 386 : Roxb. Fl. Ind. Ed. 2, 3 : 114, 1832 : Abedian in Fl. W. Pak. 33 : 1., 1973 : Theobald & Grupe in Rev. Handb. Fl. Ceylon 3 : 322, 1981 Vern. : *Bara gokhuru*, *Choumukhi gokhru* (Pedaliaceae).

A diffuse or spreading herb, up to 50 cm high; branches subsucculent or slightly woody. Roots turmeric like in colour. Leaves ovate, distantly crenate, with 2 dark-violet glands at the base of long petiole. Flowers solitary, axillary, Calyx segments lanceolate, acuminate. Corolla yellow : tube gradually widening above, scaly-glandular hairy at base. Stigma oblique, capitate. Fruit indehiscent., Pyramidal above, narrowed at base with a horizontal spine at each basal corner of broader part, 2-loculed. Seeds 2 or 1 per locule, elongate elliptic, 3-angled towards apex.

Africa, Asia, Polynesia. Occasional - along gravelly road sides and in shades of garden trees.

Fl & Fr. : August-October.

Asta DS : 336, Sahar, DS : 855.

12. *Soliva anthemifolia* (Juss.) R. Br. Ex Lesson. Syn. Compos. 268. 1833; Fl. E. Himalaya 140. 1971 (Asteraceae).

A flat, diffuse, annual herb, stem much shorter than the leaves, forming dense tufted growth, leaves radical, petiolate, simple, oblong to oblong-lanceolate. Heads sessile, several together, grayish green, enclosed within leaf bases, extremely villous hairy, 2-3mm : fruiting heads much enlarge; Involucral bracts several, 2mm long,

ovate to ovate lanceolate : Receptacle simple flat, without any scales, extremely villous within, floret in the circumference in several rows. Disc florates mostly male or sterile tubular, pale yellow, 2-3 toothed at apex, style rigid, persistent, with hooked tip.

India. Common - in ridges and moist places.

Fl. & Fr. : March - May.

Jaitpur. DS : 625.

13. *Sporobolus diander* (Retz.) Beauv. Essai Agrost, 26, 1812; FBI 7 : 247 : GBCIP 629. (Poaceae).

An erect, slender, tufted annual. Nodes glabrous. Leaves flat or convolute, smooth, strongly nerved; Panicles narrowly pyramidal, turning purplish-brown and finally brown: branches capillary, erect or spreading : in scattered fascicles or racemed. Spikelets small, 1-1.5 x 0.5 mm very shortly pedicelled. Grains truncate, obtusely quadrangular, reddish - Brown, rugulose.

India. Occasional-in ridge : shady places; and road sides\*

Fl. & Fr. : August-October

Sahar, DS : 849

14. *Urena lobata* spp. *sinuata* (L.) Borss., Bulmea 14 : 142. 1966. - *U. sinuata* L., Sp. Pl. 692, 1753; FBI. 1 : 329 : FFPUP. 2 : 53. Vern. : *Chhotidodiya* (Malvaceae).

Shrubby, 1 m high. Leaves 3-9cm long ± stellate hairy on both surfaces, cordate or truncate at base, irregularly lobbed to below the middle, lobes 3-6 or more, dilated upwards, with rounded sinuses, serrate or toothed, pale beneath, mostly with a gland near the base of the midrib and sometimes on one or both of the adjoining nerves; petioles 1-2cm long. Pedicels short, axillary, clustered. Involucral bracts 1cm long, linearoblong, acute as long as, or slightly longer than the calyx and alternate with its lobes. Calyx minutely pubescent, lobes rounded on the back, wedge-shaped on the inner side, smooth.

India. Occasional - in ridges, wasteland and fallow field.

Fl. & Fr. : September-December

Sahar, DS : 808.

Note : Kanjilal (FFPUP. 2 : 53) and Raizada & Saxena Fl. Missouri. 1 : 66, 1978 have treated *Urena sinuate* L. as under *Urena lobata* L. However, their description does not include the character of this sp.

15. *Urginea indica* Kunth; FBI. 6 : 347. FFPOGB. 379. Vern. : *Kuria kando*. (Liliaceae).

Bulb 4-8cm long, ovoid. Leaves appearing after the flowers 15-30cm long, linear, acute, nearly flat. Scape erect, 24-36cm long, brittle flowers distant, drooping or spreading, greenish-white, or dingy-brown; bracts minute, soon falling. Perianth campanulate; segments 1 cm long.

Oblong - lanceolate, obtuse, with 2 or 3 strong approximate median nerves. Stamens 1 cm or longer : filaments flattened.

India. Occasional-grow ridges; fallow lands of fores.

Fl. & Fr. : March-April (Fruit not observed)  
Jaitpur, DS : 618

16. *Vitex negando* L, Sp. Pl. 638, 1753; FBI. 4 : 583; 541 : FFPOGB. 291 : Handb. Fl. Ceylon 3 : 357, 1974 : Ali in Fl. W. Pak. 77 : 1974 (Verberaceae).

A shrub : bark thin grey; branchlets quadrangular, whitish, with a fine tomentum. Leaves 3-5 foliate : leaflets lanceolate, acute, the terminal leaflet 2-4, with a petiole long, the lateral leaflets smaller with a very short petiole all nearly glabrous above, covered with a fine white tomentum beneath, base acute; common petioles long. Flowers in pedunculate branched tomentose cymes, opposite along the quadrangular, tomentose rachis of a large terminal, often compound pyramidal panicle (axillary, caducous. Calyx long, white-tomentose; teeth triangular, corolla long, bluish-purple, tomentose outside,

hairy inside at the insertion of the stamens; upper lip long, divided to the base into 2 obtuse lobes; lower lip large, with 2 short, oblong, obtuse, lateral, lateral lobes deep, and a large broadly obovate crenulate terminal lobe long. Filaments hairy at the very base. Ovary glabrous; stigma forked. Drupe, black when ripe.

Afghanistan, Philippine Island Ceylon, India.

Common-in slopes of the rivers, unused places.

Fl. & Fr. : October-November.

Etawah : DS : 1095.

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