

## EFFECT OF GAMMA ( $\text{Co}^{60}$ ) RADIATION ON THE GROWTH AND ALKALOIDAL CONTENTS OF MEDICINAL PLANTS

### Part II. *Papaver Somniferum* L. (Papaveraceae)

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**Abstract.** The paper studies the effect of gamma cobalt-60 radiation on the growth and alkaloidal contents of medicinal plants. It was found that, when opium poppy seeds are irradiated with gamma cobalt at the 4 Krad dose, planted, and the opium is collected therefrom, the percentage of morphine recorded an increase up to 29.17%.

*Papaver somniferum* L. or opium poppy ("afim" or "afyun", "post") originated in the Western Mediterranean region, as early as the tertiary period. It spread through the Balkan Peninsula to Asia Minor<sup>1</sup>. Poppy cultivation for opium has been carried on in Italy, Greece and Asia Minor since antiquity<sup>2</sup>. At present besides Pakistan, poppy is cultivated in India, USSR, Yugoslavia, Bulgaria, Afghanistan, Japan and now also in Iran and Turkey. In 1955 Iran prohibited opium cultivation which was once its major producer.

The plant is erect, rarely branched, usually glaucous annual, 60-120 cm. high. Leaves ovate-oblong or linear-oblong, amplexicaul, lobed, dentate or serrate. Flowers large, usually bluish white with a purple base or white, purple or variegated. Capsules large, 2.5 cm. dia., globose, stalked, seeds white, reniform<sup>2</sup>.

Opium is valued for the alkaloids it contains: morphine, codeine, thebain, narcotine, narceine and papaverine are the chief opium alkaloids and of these morphine is the most abundant and by far the most important alkaloid. The value of opium depends upon its morphine contents. Indian opium, as prepared for medicinal purposes and the manufacture of alkaloids, contains 12% of morphine as maximum<sup>2</sup>. In Pakistan it was found 10.38% as average of 22 lancings<sup>3</sup>; and 10.59, average of 15 lancings (analyses of opium collected from the untreated plots in the present work).

Morphine is used to relieve pain, anxiety and sleeplessness due to pain. It also reduces all disagreeable sensations apart from skin irritation. It is invaluable in the treatment of biliary or renal colic, severe traumas, internal haemorrhage, myocardia, infraction and congestive heart failure. As a sedative to the respiratory centre, it is of special value in cardiac asthma and whooping cough<sup>2</sup>.

### Cultivation and Treatment

Due to the growing demand of the pharmaceutical industry for the alkaloid morphine, the present studies were carried out in an attempt to increase the percentage of morphine by irradiation method.

Seeds were sent to the NIAB, Faisalabad, for exposure to gamma cobalt irradiation in the following random doses: i.e., 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 7.0, 8.0, 9.0, 10.0, 20.0, 40.0, and 60.0 (Krad). Meanwhile a good land area of about 100 sq. yd. was selected for cultivation. This land was ploughed two times, all weeds and grass were thoroughly destroyed. The soil was a slightly clayey and therefore sand was added to it according to the requirement of the soil, and cow dung was applied in sufficient quantity. Fifty seven plots of size 10.67 × 3.50 sq. m., were made in three rows, each row having 19 plots. One plot in each row was kept for untreated seeds. Plots were allotted to each dose of irradiated seeds according to randomized block system of cultivation (Fig. I). The sowing was complete by the mid of November. The seeds were sown in 0.61 m. wide rows and later on thinning was done to maintain a distance of approximately 0.10 m. from plant to plant. Care was taken to make sure as far as possible that there was a uniform growth in lines and no gap existed in any replication.

Necessary hoeing, weeding and watering were done at proper intervals.

Lancing for opium collection was started by the middle of April and continued until the end of the month in all the plots except nine plots, in which 20.0, 40.0, and 60.0 Krad, irradiated seeds were sown. These doses seem harmful as only a few seeds germinated and even these plants died down even before maturity.

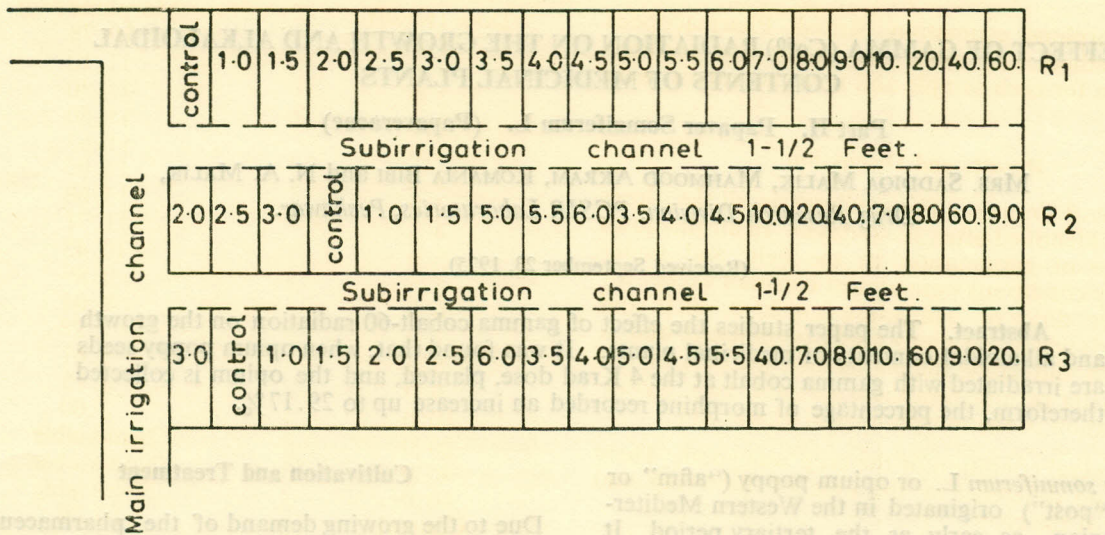


Fig. 1. Randomized block design cultivation:  
 R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, (Replication) 1.0—60.0 Krad  
 Radiation) doses  
 Total area 1000 sq. ft. Net plot size 35×10 sq. feet.

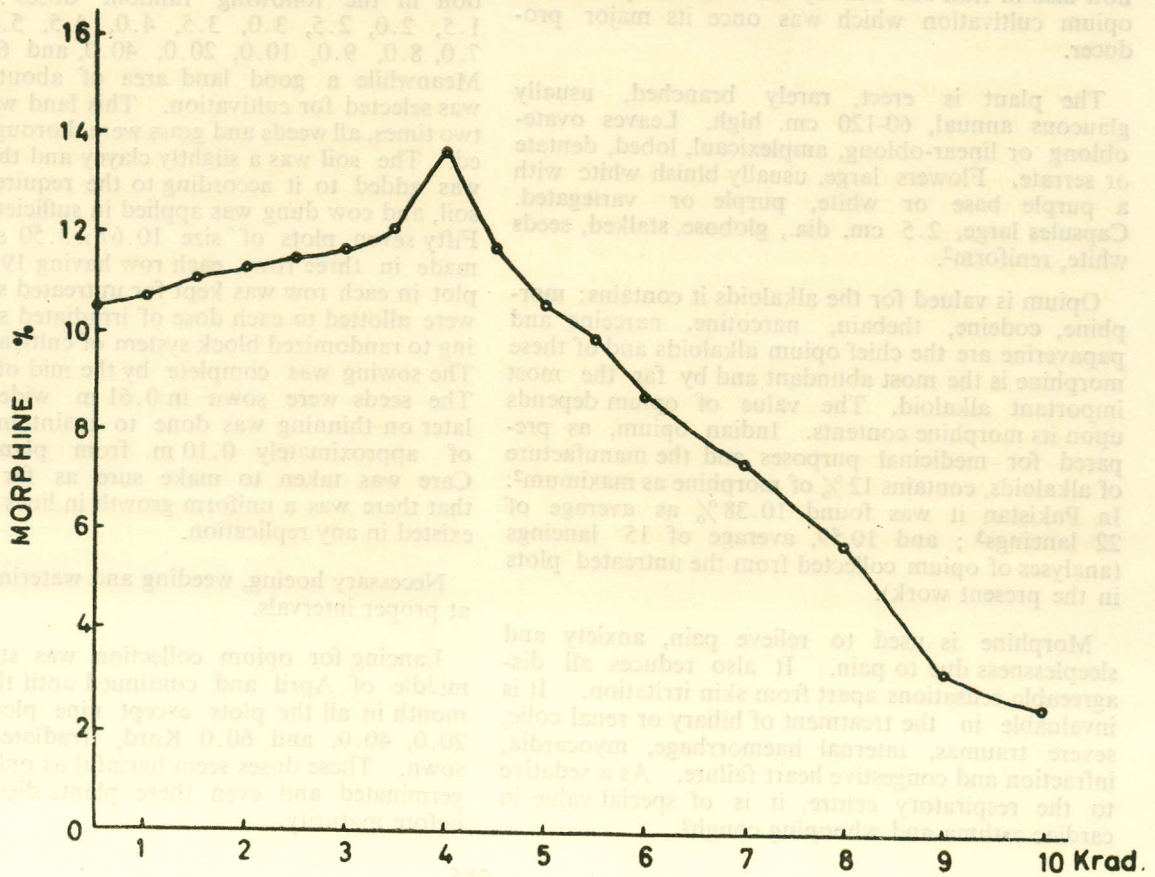


Fig. 2. Percentage of Morphine in relation to different doses of gamma rays.

## Morphine Estimation

For morphine estimation, British Pharmacopoea 1968<sup>4</sup> method was used. At least five readings were taken for each sample and then the values were averaged.

## Results and Discussion

(i) *General Growth.* The seedlings in all the doses could be identified after 30-40 days. In all the doses percentage of germination in the field and under laboratory conditions were almost constant except for the higher doses of irradiation (*i.e.* 20.0, 40.0 and 60.0 Krad) where not many seeds germinated and a few which did come the plants died within a month or so. After germination there was not very significant variation in the morphological characters.

The general condition of the crop was good. There was also no difference in the time of flowering and maturity of the crop.

The crop was mature by the middle of April at which time the first lancing of the capsules was done. These lancing were continued up to the end of the month.

The effect of irradiation on the yield of raw opium from *Papaver somniferum* was not studied in the present trials.

After collecting the opium from all the experimental plots, it was shade-dried on leaves and stored in sealed containers.

(ii) *Chemical Analysis.* The chemical analysis of opium for the percentage of morphine in treated as well as control plants are given in the Table. The percentage of morphine shown in the Table is the average of 5 determinations of the samples, which were themselves the accumulation of 15 lancing from each plot.

As is obvious from the Table the percentage of morphine gradually increased with increasing the dose of irradiation till a certain stage, (*i.e.* 4 Krad dose) where it reaches the optimum degree, *i.e.* 13.68% (Fig. 2). After 4 Krad dose the morphine content starts decreasing with each successive dose (Fig. 2). The plants are no more viable and died when treated at higher doses such as 20.0, 40.0, 60.0 Krad (Table).

TABLE

Dose (Krad)	Morphine (%)
1.0	10.78
1.5	11.10
2.0	11.30
2.5	11.50
3.0	11.63
3.5	12.05
4.0	13.68
4.5	11.71
5.0	10.45
5.5	9.89
6.0	8.64
7.0	7.28
8.0	5.61
9.0	3.15
10.0	2.00
20.0	Non-viable
40.0	Non-viable
60.0	Non-viable
Control	10.59

The above results clearly show that when opium poppy seeds are irradiated with gamma cobalt at the 4 Krad dose and then planted and the opium is collected, there is increase in the percentage of morphine upto 29.17%.

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## References

1. Farmile *et. al.*, Bull. Narcotics, Vol. 5 (1), p. 26, (1953).
2. The Wealth of India (Counc. Sci. Ind. Res. New Delhi, 1966), Vol. VII (Raw Materials) pp. 240-244.
3. M. Imam, Pakistan J. Forestry, Vol. 14 (3), p. 187, (1964).
4. Brit. Pharmacop., (General Med. Counc. London, 1968), p. 684.