EFFECT OF GAMMA RADIATION ON GERMINATION AND GROWTH OF *CENCHRUS CILIARIS* LINN (DHAMAN GRASS)

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Abstract

A study to find out the beneficial effects of radiation on *Cenchrus ciliaris* was carried out at University of Agriculture and Nuclear Institute for Agriculture and Biology Faisalabad. The dry seed was treated with 1, 3, 5, 7, 9, 10, 15, 20, 25, 30, 35 and 40 KR. Doses of 7 to 15 KR doses showed significant increase in tillering, plant height, fresh and dry matter yield. Flowering was earlier in 5 to 15 KR and delayed for other doses. Germination was not much affected. Pollen fertility gradually decreased with the increase in radiation dosage.

Introduction

Grassland agriculture is one of the important components of agriculture, as it is inseparably linked to livestock production. With good management practices, it is possible to increase the production of digestible nutrients on the range and reduce the labour costs to crop and utilize fodder. Despite its great importance in our economy, this sector has not been fully exploited and range management is perhaps the most neglected area in our economy.

A number of grasses grow naturally in our ranges, "Dhaman" or Buffel grass, (*Cenchrus ciliaris* Linn) is an important native grass of Pakistan in tropical and sub-tropical areas. It survives close grazing and provides nutritious feed in the hot deserts of Pakistan. Because of its widespread occurrence, and good palatability and feed values, this grass is much grazed by livestock.

Radiation has lately been used as an effective tool for boosting production of many members of the gramineae. The response to radiation is, however, not uniform. The effects of radiation on grasses have reported to be controversial. This study reports the results of radiation on the germination, growth, and reproduction of *Cenchrus ciliaris.*

Materials and Methods

The seed of local strain of "Dhaman" (*Cenchrus ciliaris* Linn) was collected from the Bhakkar range. Dry seed was treated with 1, 3, 5, 7, 9, 10, 15, 20, 25, 30, 35 and 40 KR of gamma radiation from the Co^{60} source (1000 Curri– 150 Gamma Beam) at Radiation Genetics Institute, Faisalabad. Untreated seed was sown as control. The experiment was designed in completely randomized block with four replications. Pollen from freshly dehisced anthers was taken on the slides and the material stained with potassium iodide solution.

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The data were subjected to Analysis of Variance for testing the significance of different treatments. LSD. test was used for individual comparisons.

Results

Effects on growth

Germination was uniform in control but in radiated material emergence was uneven. (Fig 1). Germination in treated seed did not differ significantly from control. These results are in confirmity with the findings of Nuttall *et al.* (1968)., Rajput (1970) and Sparrow (1961). Suss (1966) and Sax (1963), have also reported similar results in many crops after low dose treatment. No significant decrease, in germination even at higher radiation dose i.e., 40 KR was observed in the present study.

It is perhaps due to the fact that the seed of *Cenchrus ciliaris* is very small in size. The possible reason for some increase in the germination of seed at low dose irradiation may be due to increased enzymatic activities as well as affect on the mitotic division or induction of other changes in the physiological phenomen which decrease germination.

As increase in plant height is a desirable character for improving the forage yield, effect of gamma–radiation on *Cenchrus ciliaris* height was studied as is presented in fig. 2.

The average height of the untreated plants was 38.4 cm whereas plants from treated seed showed increasing trend in height growth reaching 48 cms at 10 KR dosage. The height declined to 40.8 cm 'at 40 KR. Same trend have been reported by Suss (1966), Sparrow (1966), and TaVcar (1966). Kuzin (1955). Sub and Grobe (1968) have also reported similar results in different crops under varied climatic conditions, but Ghafoor *et al* (1968), and Rajput (1970) reported decrease in plant height with corresponding increased doses in wheat. The contradictory effects reported by various workers cited above, may be attributed to differences in genetic composition of material used. The increase in plant height may be explained on the basis of the destruction of an inhibitor, or by the release of an activator.

Effect of gamma radiation on number of tillers per plant is shown in fig 3. The mean tillering number in the control plants was 8.3 but in treated seed plant, tillering increased to 13.3 with 7 KR treatment. Higher doses then 10 KR adversely affected tillering reaching only 9.2, at 40 KR. Differences of tillering between treated and untreated plants was statistically highly significant. These results are in confirmity with the findings of Ghafoor *et al* (1968), Sax (1963), Cervigni *et al* (1962) and Leophold and Thimann (1949).

Goud (1967-68) however observed a significant increase in tillering of a highly neglected variety of wheat, but a definite decrease in a highly improved variety, at the same dose. There was no change in case of a medium tillering variety.

Radiation effects on flowering are shown in fig 4. Untreated plants took 35 days as against 30 days in treated seed plants at (15 KR). The doses up to 15 KR decreased the preblooming vegetative period. It was 40 days with 40 KR treatment. Early flowering with low doses of radiation has also been reported by Ghafoor *et al* (1968), Sax (1963), Bhatt *et al* (1961). Tedoradze (1961) observed delayed flowering in legumes with increased grain yield. Possibly the hormone "florigen" which is supposed to be responsible for flowering, may be initiated earlier in treated plants than in untreated. The production of florigen is perhaps delayed with higher doses.

Dry matter of *Cenchrus ciliaris* was significantly affected by gamma radiation (fig. 5). Maximum dry matter Av. (11.9 grams) per plant was obtained at 10 KR while it was only 5.3 gms, in control plants. The lower doses showed a favourable effect on dry matter yield and higher doses decreased it. As the gamma-irradiation approached at 40 KR the yield was 6.0 grams per plant almost the same level as control. Increase in dry matter is mostly due to increase in height and tillering of these plants. Doses higher than 15 KR have detrimental effect on the dry matter yield in most of the crops. However, in the less improved species the radiation has a possitive effect on the yield (Goud 1968). Increase in dry matter yield has been reported by Kuzin (1955), Suss (1966), Shull and Mitchell (1933), Wort (1941), and Sparrow (1966). Present studies are in confirmity with the results of the investigators, mentioned above. Increase in dry matter yield may be due to increased enzymatic activity and higher doses seem to inhibit certain physiological effects resulting in low dry matter yield.

Pollen fertility decreased with corresponding increases in the dose rates (fig–6). It was 94.8% in controls and 71.9% at 40 KR most of the pollen grains were found wrinkled. The inverse relation of gamma-radiation was highly significant statistically.

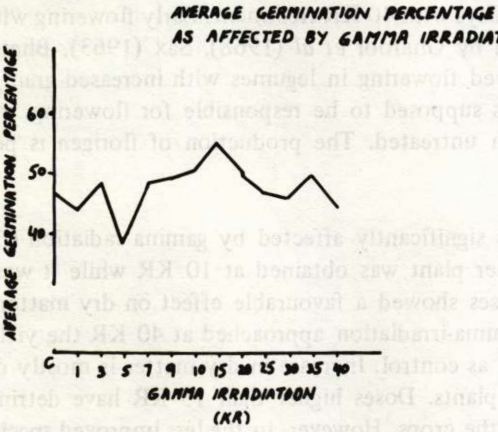
Siddiq and Swaminathan (1968), Saha *et al* (1972) have reported similar trend in Rice. The only difference is that they observed much more sterility at 40 KR as compared with *Cenchrus ciliaris*.

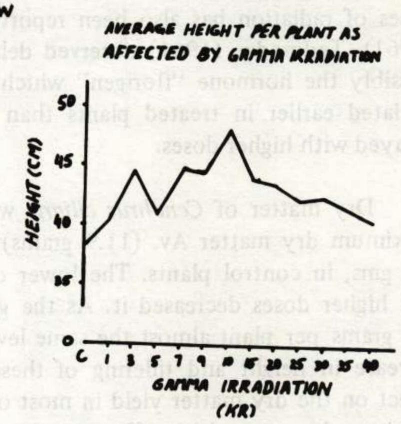
It appears that *Cenchrus ciliaris* is much more resistant to radiation due probably to small seed size, compact mass and less moisture percentage than rice. Occular estimates in *C. ciliaris* showed that the seed formation was not much affected by the pollen sterility even up to 40 KR. This indicates that 71.9% pollen fertility observed at this dosage was quite sufficient for seed formation.

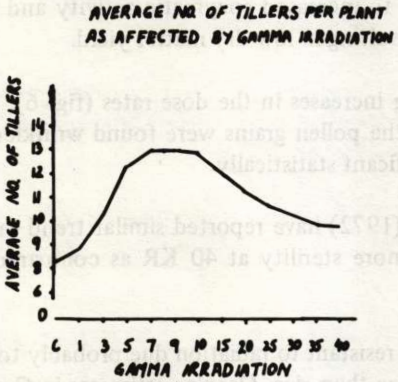
Conclusion

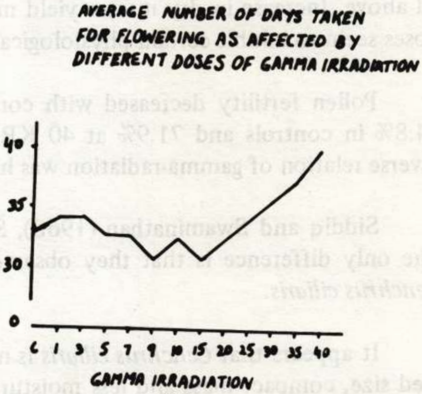
On the whole, the radiation treatment has shown positive effects on various growth characters of *Cenchrus ciliaris* Linn. i.e. Plant height, tillering and dry matter were increased by 7 to 15 KR doses. The pollen fertility at these doses ranged from 83.88 to 90.3 per cent which is normal for pollination and seed setting.

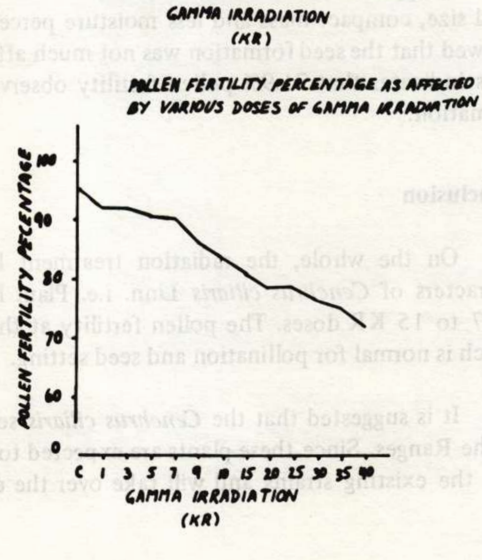
It is suggested that the *Cenchrus ciliaris* seed irradiated with 7 to 15 KR doses be sown in the Ranges. Since these plants are expected to grow more vigorously, they are likely to outgrow the existing strains and will take over the entire ranges in due course of time. This grass

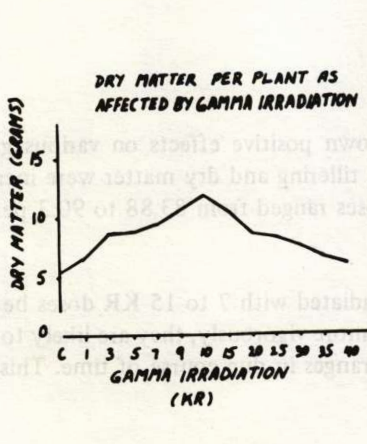

AVERAGE GERMINATION PERCENTAGE
AS AFFECTED BY GAMMA IRRADIATION
AVERAGE GERMINATION PERCENTAGE
60
50
40
C 1 3 5 7 9 10 15 20 25 30 35 40
GAMMA IRRADIATION
(KR)


AVERAGE HEIGHT PER PLANT AS
AFFECTED BY GAMMA IRRADIATION
HEIGHT (CM)
50
45
40
35
0
C 1 3 5 7 9 10 15 20 25 30 35 40
GAMMA IRRADIATION
(KR)


AVERAGE NO. OF TILLERS PER PLANT
AS AFFECTED BY GAMMA IRRADIATION
AVERAGE NO. OF TILLERS
14
13
12
11
10
9
8
7
6
0
C 1 3 5 7 9 10 15 20 25 30 35 40
GAMMA IRRADIATION
(KR)


AVERAGE NUMBER OF DAYS TAKEN
FOR FLOWERING AS AFFECTED BY
DIFFERENT DOSES OF GAMMA IRRADIATION
NO. OF DAYS
40
35
30
0
C 1 3 5 7 9 10 15 20 25 30 35 40
GAMMA IRRADIATION
(KR)


POLLEN FERTILITY PERCENTAGE AS AFFECTED
BY VARIOUS DOSES OF GAMMA IRRADIATION
POLLEN FERTILITY PECENTAGE
100
90
80
70
60
0
C 1 3 5 7 9 10 15 20 25 30 35 40
GAMMA IRRADIATION
(KR)


DRY MATTER PER PLANT AS
AFFECTED BY GAMMA IRRADIATION
DRY MATTER (GRAMS)
15
10
5
0
C 1 3 5 7 9 10 15 20 25 30 35 40
GAMMA IRRADIATION
(KR)

being perennial, need not be sown each season. This with increase the production of range-lands.

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