The present investigation comprises a study of photoperiodism and related phenomena in nine strains of indica rice. A concise summary of the tangible experimental results is presented.

1. An exposure of 14-day-old seedlings in three winter varieties of rice, BAM 3, BAM 11 and BAM 14 to 8 hr short photoperiod for 1 and 2 weeks delayed heading by 2 to 8 days; the same photoperiod beyond 3 weeks accelerated heading by 18 to 33 days, the degree of acceleration being directly proportional to the dose of the short day treatment. This demonstrates that a critical dose of the short-photoperiod is an absolute requirement for flower induction in rice. At the age of 14 days a short photoperiod for 3 weeks minimum is necessary for ear initiation. Short photoperiod significantly decreased the grain yield due to cumulative deleterious effect on the components of yield such as the number of panicles per plant, panicle length, spikelets per panicle, grains per panicle, seed setting and weight of 1000 grains.

2. Studying the effect of 8 hr photoperiod on the microsporogenesis of the most photosensitive of these varieties, BAM 3, it was shown that the short-day treatment for 1 and 2 weeks caused vacuolation in the cytoplasm of the sporocytes.
Exposure for 3 weeks caused a high degree of vacuolation in the cytoplasm of the sporocytes to the extent that such sporocytes showed no further meiotic divisions. The treatment of 4 weeks duration caused lagging of chromosomes in 10% of the sporocytes. Formation of 2 nucleate abnormal pollen was noticed at a frequency of 20% as against 1.5% in the control plants. The treatment for 5 weeks and that continued till anthesis, caused considerable contraction of the nucleus in sporocytes which did not divide further. In addition, the treatment caused loose pairing of chromosomes at Pachytene stage at a frequency of 20% and univalents at Metaphase I at frequency of 5%. Pollen grains with 2 or 3 micronuclei were found and also morphologically normal pollen in the flower buds collected from plants subjected to short photoperiod till anthesis. Pollen sterility in the short-day treated plants was greater than that of the control plants. The percentage of pollen sterility increased with an increase in the dose of the short photoperiod. Pollen sterility seems to be the net result of meiotic irregularities noticed during the course of meiosis.

3. In order to determine the impact of dose of the short photoperiod on age of rice plant in the same photosensitive variety, BAM 3, an 8 hr short photoperiod was given to 7-day-old seedlings for 1, 2 and 3 weeks and this caused a delay of 6.41 to 15.33 days in ear emergence; that exposed for 1 and 2 weeks had no effect, positive or negative, in 14-day-old seedlings, but the same for 3 weeks induced earlier ear emergence by 78 days. Short photoperiod for 1 week delayed ear emergence by 7 days even in 21-day-old plants but for 2 and 3 weeks induced earlier flowering.
by 71 to 77 days. With 28 days a week of short photoperiod is just enough for induction of earlier ear emergence demonstrating that at this age, the plants of this variety crosses the critical juvenile phase for photoreponsiveness. Short photoperiod, however, significantly decreased the grain yield from that of the controls, the quantity of degrees depending upon the age of the plant at which the short photoperiod was administered and also on the duration of the treatment.

4. In order to make general determinations concerning the effect of short photoperiod in induction of flowering in rice the experiment was widened to include, in addition to BAM 3, eight other winter varieties - BAM 9, BAM 11, T.141, NTU 3, CIR 302, C.R 1014 and S.R. 26B. Eight hour short photoperiod for 1 week brought about a significant delay in heading in all the nine varieties tried; a significant delay but the same treatment for 2 weeks gave the reverse pattern and caused earlier heading in seven varieties. Short photoperiod for 3 weeks and more induced progressively earlier flowering in all the nine varieties, the magnitude of earliness being proportional to the duration of the treatment. It seems that BAM 14 and NTU 3 crosses the critical juvenile phase at the age of 35 days while the other seven varieties cross the critical juvenile phase at the age of 28 days. Short photoperiod decreased the grain yield in all the nine varieties, the decrease being more with an increase in the duration of the short-day treatment.
5. The next factor studied was the impact of short photoperiod on seasonal sowing in the late-winter photosensitive variety, BAM 3. Sown on the 1st day of every month during the period from August 1964 to July 1965 a set of plants were subjected at the age of 28 days to 8 hr photoperiod for 21 days, and grown thereafter in natural daylength along with the controls till flowering and subsequent harvest. Plants grown in natural daylength from the very beginning as controls remained vegetative till they received in nature a critical night length of not less than 11.26 hr and an optimum temperature for pigment (phytochrome) conversion. Thus the plants sown during the months of February to July developed ear emergence in the following October, plants of August sowing developed to ear emergence in November. Plants sown in August October developed to ear emergence in December and plants sown from November to January developed to ear emergence in March. The 8 hr short photoperiod induced a markedly earlier flowering in treated plants regardless of the months of sowing. Grain yield was higher in the control plants than that of the treated plants in all the monthly sowings, while late sowings remarkably reduced the grain yield in the control plants.

6. The study of the interaction of short photoperiod and seasonal sowings in the late-winter variety, BAM 3, was extended to two more varieties, BAM 11 (mid-winter) and BAM 14 (early-winter). The three varieties responded uniformly in that shifting of the date of sowing from month to month both under the natural photoperiod and under 8 hr short photoperiod greatly altered the time of flowering.
Twenteight-day-old plants subjected to 8 hr short photoperiod for 21 days in each monthly sowing flowered conspicuously earlier than the corresponding controls under natural daylength. Among the three varieties the longer the normal duration of a variety, the shorter was the period taken by that variety to flower under short days in each month of sowing. Grain yield was adversely affected by late sowings in September, October, November and December and January in all the three varieties. The mechanism of flowering in rice has been explained in terms of formation of flowering hormone consequent upon the synthesis of suitable phytochrome dependent upon the critical night length and critical night temperature available to the plants at the time of conversion of the vegetative apex to the floral primordium.

7. In studying the effect of continued long dark periods in the highly photosensitive BAM 3, it was seen that the number of plants showing ear initiation was maximum with cycle length of 24 hr while the minimum number of plants showing ear initiation was with cycle length of 72 hours. Failure of the synthesis of critical quantity of flowering hormone in dark periods longer than 24 hours is ascribed as the cause for the non-induction of flowers in plants.

8. The long dark periods were interrupted by light breaks varying from 2 to 8 hrs. Plants receiving 8 hr photoperiod plus 16 hrs. darkness showed maximum ear initiation (100%) while the plants which received 12 hr photoperiod plus 12 hrs darkness showed ear initiation in 60% of plants. The plants which received 8 hr
photoperiod plus 16 hr darkness with light interruption either at the beginning or at the end of the dark period did not come to flower at all. Short-day inductive cycles appear to be effective in flower induction when given in direct succession and ineffective when inductive cycles are separated by one or more non-inductive cycles.

9. Shoot apex study following 1 to 12 consecutive short-day cycles at the age of 28-day-old seedlings of BAM 3 revealed that seven consecutive photoinductive cycles played a master role and brought about ear initiation 50 days earlier and ear emergence 61 days earlier than in the plants grown in nature as controls. Although the existence and the nature of flowering hormone remain controversial, it appears that only a study of biochemical changes in the apex will be able to throw light on the mechanism controlling flowering in the rice plant.

10. Eight hour short photoperiod resulted in a gradual increase in rate of respiration with each photoinductive cycle up to the 8th day in the shoot apices and up to the 6th day in the leaves in the late-winter strain, BAM 3. With additional doses of photoinductive cycle there was a gradual decline in the rate of respiration. Thus there was an overall increase in the rate of respiration in photoinduced plants, both in leaves and shoot apices, compared to those of the controls at the same stage of growth. Photoperiodic mechanism by which flowering is induced in rice appears to involve a respiratory change.

11. Sugar content of the leaves of the photosensitive BAM 3 following short-day induction gradually increased with an increase
in the number of photoinductive cycles, reaching a maximum value with 7 photoinductive cycles at which time ear initiation was observed in 80% of the plants. The sugar content of the control plants, however, was higher than that of the treated plants all through the period of study.

12. The nitrogen content of the leaves in the same variety, BAM 3, was much higher in the short-day treated plants than that of the control plants throughout the period of study. The nitrogen content of the leaves gradually rose with the number of photoinductive cycles, reaching the maximum value with 7 photoinductive cycles and thereafter gradually declining with additional doses of short photoperiod.