II. EFFECT OF PHOTOPERIOD, TEMPERATURE AND CHEMICALS ON GROWTH, FLOWERING AND SEX EXPRESSION IN CUCURBITS
Photoperiod is found to influence sex-ratio in several species and varieties of cucurbitaceous plants. Effect of light on sex-expression of cucumber is first reported by Tiedjens (1923). According to him abundance of light within certain limits tends to increase the number of male flowers and vice versa. Edmond (1930) in his experiment on cucumber has also observed marked increase in the production of female flowers due to low temperature and longer dark period. Short day promotes pistillate flowers in bush pumpkins (Scott, 1933) and gherkin (Hall, 1949). Mitsch (1962) reports that Acorn squash, cucumber and gherkin plants exposed to long day and high temperature (30°C) do not develop female flowers but at the same temperature under short day they produce female flowers. Plants treated with lowest temperature combination (20°C day and 10°C night) under long and short days produce female flowers at lower nodes. Lower temperature and short day have also been found to stimulate formation of female flowers in cucumber (Fuji, 1954; Shiffriss and Galun, 1956; Ito and Saito, 1967 and Sekiya, 1967). Positive effect of low temperature and short day for the production of pistillate flower has also been reported by Natsuo (1968) and Fukushima et al. (1968) on several varieties of cucumber.

The adverse effect of long day and high temperature on cucurbits has been counteracted by using NAA at 10 ppm (Ito and Saito,
and by treatment with high dose of nitrogen and NAA (Brantley and Warren, 1958, 1960). TIBA and GA have proved effective in increasing the number of pistillate flowers in watermelons even under long day and high temperature conditions (Chowdhury, 1966).

The effect of temperature on sex-expression is first reported by Geddes and Thompson (1899). They observe production of only male flowers in watermelon grown in glass house at 110°F and only female flowers in cucumber under lower temperature. Junges (1954a) finds that exposure of the dormant seeds to 35°C accelerates flowering by one week and higher yields are obtained with the treatment of 2 cucumber varieties to 40°C and 60°C for 2 hours (Junges, 1954b). Veselovskaja (1954) reports higher yields in watermelons and cucumber by treating the seeds with 55-60°C for 4 hours.

Considering the role of photoperiod and temperature and factors influencing the response due to photoperiod on sex-expression of cucurbits, the following experiments were taken up:

1. Effect of photoperiod on growth, flowering and sex-expression in cucumber, longmelon, snapmelon, ridge gourd, bitter gourd and round gourd.
2. Effect of seed treatment of cucumber and ridge gourd with CCC, coumarin and GA and exposure of the treated seedlings to short and long day on growth, flowering and sex expression.
3. Effect of temperature treatment of seeds on growth, flowering and sex expression in cucumber, longmelon, snapmelon, ridge gourd, bitter gourd and round gourd.
4. Effect of temperature treatment of seeds of cucumber and ridge gourd and exposure of the treated seedlings to different photoperiods on growth, flowering and sex expression.
MATERIALS AND METHODS

Experiment 2a

Photoperiod:

Pure monoecious line of cucumber cv. Kalyan, long melon cv. Jainpuri Long, snap melon cv. Sweet, ridge gourd cv. Long Green, bitter gourd cv. Small Green and round gourd cv. Round White was used in this experiment.

Three seeds of each variety were sown in a 20 cm earthenware pot containing a rich compost made of 2 parts loamy soil and one part each of well-decomposed cow-manure and screened leaf mould. A tablespoonful of sterameal was mixed in the compost of each pot. The seedlings were exposed to three light periods: (i) 16 hours (long day), (ii) 8 hours (short day) and (iii) natural day length between 12 hours 4 minutes to 12 hours 10 minutes.

Long day treatment was given by exposing the plants to sunlight from 6:00 A.M. till the sun set and then under artificial light with an intensity of 200 f.c. per square metre up to 10:00 P.M. For short day treatment, plants were exposed to sunlight from 8:00 A.M. to 4:00 P.M. and then removed to a dark room for the rest of the period.

Sowing was done in the first week of March. One healthy
seedling was kept in each pot and exposed to different light periods beginning from germination up to 15 days after the appearance of first flower. The plants were then removed to natural light period. Staking was done to support the plants and it was watered almost regularly to prevent drying of the soil during the summer months. Ten plants were used for each treatment.

Experiment 2b
Seed treatment with chemicals and photoperiod:

Seeds of cucumber cv. Kalyan and ridge gourd cv. Long Green were selected for this experiment. The seeds were first washed with distilled water and then soaked in 1, 10 and 100 ppm of CCC, coumarin and GA.

The seeds were kept in the solution for 48 hours at room temperature (22°C). Three treated seeds of each variety were sown in 20 cm earthenware pots containing the rich compost as mentioned in experiment 2a. Sowing was done in the first week of March. One healthy seedling was kept in each pot and exposed to long day (16 hours light), short day (8 hours light) and natural day (12 hours light, 4 minutes to 12 hours, 10 minutes) beginning from germination up to 15 days after the appearance of first flower in the same way as described in the previous experiment. Ten plants were used for each treatment.

Experiment 2c
Temperature treatment of seeds:

In this experiment seeds of cucumber cv. Kalyan, longmelon
cv. Jainpuri Long, snapmelon cv. Sweet, ridge gourd cv. Long Green, bitter gourd cv. Small Green and round gourd cv. Round White were used.

The seeds of the above mentioned cultivars were sown in washed and moist coarse sand in petridish and kept at 3 different temperatures for 96 hours in dark: (i) 4°C, (ii) 15°C and (iii) 40°C.

The germinated seeds were sown in well prepared and manured pit 8 metres at a distance of 2 x 2 metres. One plant was grown in each pit and ten plants were used for each treatment.

Experiment 2d

Temperature treatment of seeds and photoperiod:

Seeds of cucumber cv. Kalyan and ridge gourd cv. Long Green were selected for this experiment. The seeds were sown in washed and moist coarse sand in petridish and kept at 3 different temperatures (4°C, 15°C and 40°C) for 96 hours and the germinated seeds were then sown in 20 cm earthenware pots containing rich compost in the first week of March. The plants obtained from the seeds kept under different temperatures were exposed to three light periods - short day (8 hours), long day (16 hours) and natural day length beginning from the 5th day after sowing in pot up to 15 days after the appearance of first flower.

In all the experiments, data on length of the plants, number of nodes on the main stem, date of appearance of first flower, position of the first female flower on the main stem, total number
of male and female flowers on the main stem and branches were collected till the plants showed sign of senescence.
RESULTS

Experiment 2a

Photoperiod:

Cucumber cv. Kalvan

Data on the vegetative growth of the plants, number of male and female flowers and sex-ratio are presented in Table 18.

Length: Plants under long day condition significantly increased in length as compared to those grown under short and natural day.

Node number: Short day plants developed less number of nodes than in other two treatments.

Position of first female flower: Plants exposed to short day produced the first female flower at comparatively lower node than those grown under natural day. Long day plants failed to develop flower buds.

Female flowers:

(i) Main shoot: As evident from the data in Table 18 short day plants produced about 255 per cent greater number of female flowers on the main shoot than under natural day length.

(ii) Branches: On the branches also, 260 per cent larger number of female flowers developed due to short day treatment.

(iii) Total: Because of increased number of female flowers on
the main stem and branches, total number of female flowers per plant under short day improved significantly and about 270 per cent increase was recorded due to longer dark period.

**Male flowers:**

Although larger number of male flowers was recorded on main shoot and branches of plants under natural day length, the difference among the treatments was not statistically significant.

**Ratio:**

The female to male flower ratio decreased markedly in the plants under short day condition.

**Longmelon cv. Jainmuri Long**

Effects of different day lengths on growth and flowering of longmelon are shown in Table 19.

**Length:** Short day treatment caused significant reduction in the length of the vines, but no appreciable difference was recorded between the other two treatments.

**Node number:** There was no significant difference in the number of nodes in the plants grown under different day length.

**Position of first female flowers:** Short day plants produced first female flower at comparatively lower nodes than those grown under natural and long day conditions.

**Female flowers:**

1. **Main shoot:** Though the number of female flowers under different treatments was small, yet the variation due to light periods was significant and plants under short day developed abc
Effects of different photoperiods on growth and flowering in different species of cucurbits.

Fig. 18 - *C. melo* var. *Utilissimus.*
Fig. 19 - *C. melo* var. *Momordica.*
Fig. 20 - *Momordica charantia.*
Fig. 21 - *Momordica charantia.*
70-80 per cent larger number of female flowers compared to the other two treatments.

(ii) Branches: Plants under short day produced about 200 per cent more female flowers than those under natural and long day. But the latter two treatments did not show any appreciable difference in the number of female flowers.

(iii) Total: As evident from the data in Table 19, short day plants developed significantly larger number of female flowers and the increase was 170 per cent more compared to other two treatments (Fig.19).

Male flowers:

(i) Main shoot: Male flower production was significantly increased in the plants under short day compared to natural and long day plants.

(ii) Branches: Long day treatment significantly increased the number of male flowers and the difference due to short and natural day was not very pronounced.

(iii) Total: Maximum number of male flower was found to develop in the long day plants.

Ratio:
The ratio of female to male flowers decreased markedly in the short day plants.

Snapmelon cv. Sweet

Data on the vegetative growth and flowering on the main shoot and branches are presented in Table 20.
Length: Significant retardation was recorded in the length of the vines under short day condition compared to natural and long day plants.

Node number: Plants exposed to natural and short day condition showed significantly less number of nodes than the plants under longer photoperiod.

Position of first female flower: Short day plants developed the first female flower at lower node than natural and long day plants, while plants under longer photoperiod developed it at higher node than those grown under natural day.

Female flowers:
(i) Main shoot: Plants under natural and short day produced significantly larger number of female flowers on the main shoot than that under longer photoperiod, but no appreciable difference was noted between natural and short day plants.
(ii) Branches: Plants under longer dark period produced significantly larger number of female flowers on the branches as compared to the other two treatments.
(iii) Total: On the short day plants number of female flowers increased by 36 and 74 per cent compared to those under natural and long day conditions (Fig. 19).

Male flowers:
Longer dark period also suppressed maleness in this species of plant and maximum number of male flowers developed under long day which was 128 per cent more than that produced under natural day length.
Ratios

The female to male flower ratio decreased markedly in the plants under short day (1:9.4) and natural day (1:10.9), compared to that under long day (1:31.8).

Ridge gourd cv. Long Green

Data on length of the plants, number of nodes and number of male and female flowers and its ratio on the main shoot and branches produced under different photoperiod are presented in Table 21.

Length: Length of the main stem was reduced under long dark period.

Node number: Under long day, the plants not only increased in length but also developed larger number of nodes.

Position of first female flower: Short day treatment was found very effective in inducing the first female flower at lower node compared to natural day. Long day plants failed to develop flower buds.

Female flowers:

(i) Main shoot: Although, short day plants developed larger number of female flowers on the main shoot, but it showed no significant difference from that obtained under natural day.

(ii) Branches: Number of female flowers on the branches under short day increased by 100 per cent compared to that recorded under natural day.

(iii) Total: Short day treatment produced about 56 per cent more number of female flowers than normal day treatment.
Male flowers:
Significant reduction in the number of male flowers on the main shoot and branches was recorded in the short day plants.

Ratio:
The ratio of female to male flowers decreased in the plants under short day.

Bitter gourd cv. Small Green

Effect of photoperiod on the vegetative growth and flowering is presented in Table 22.

Length: The length of the plants decreased with longer dark period and maximum reduction was recorded under short day (Fig. 20).

Node number: Number of nodes also decreased under short day.

Position of first female flower: Short day treatment was found to be effective in developing the first female flower at lower node than other two treatments. Plants under natural day length produced the first female flower at lower node compared to those under long day.

Female flowers:
(1) Main shoot: Plants under natural day and short day treatments developed 208 and 238 per cent increased number of female flowers compared to long day plants, but no appreciable difference was noted between the first two treatments.

(ii) Branches: Short day plants produced significantly increased number of female flowers on branches compared to those under other two treatments.
(iii) Total: Longer dark period promoted formation of female flower per plant by 50 and 90 per cent over natural and long day respectively (Fig. 21).

Male flowers:
Plants under natural day length developed minimum number of male flowers both on the main stem and branches. Short day treatment also suppressed production of staminate flowers.

Ratio:
Female to male flower ratio under natural and short day was found to decrease markedly compared to that under long day.

Round gourd cv. Round White
Data on the vegetative growth of the plants, number of male and female flowers and its ratio on the main shoot and branches are presented in Table 23.

Length: Longer dark period (SD) caused maximum reduction in length of the main stem and longer photoperiod promoted the length of the vines.

Node number: Similarly the node number also decreased under short day.

Position of first female flower: Treatment with increased duration of light developed the first female flower at higher node and short day plants produced the female flower at the lowest node.

Female flowers:
(1) Main shoot: In this species also plants under short day
produced 46 and 400 per cent larger number of female flowers on the main stem than those under natural and long day, respectively.

(ii) Branches: Natural and short day treatments stimulated formation of pistillate flowers; on the branches and marked reduction was recorded in the long day plants.

(iii) Total: Plants under longer dark period developed 29 and 308 per cent more number of female flowers per plant as compared to those under natural and long day respectively.

Male flowers:

Significant reduction in the number of male flowers on the main shoot and branches was recorded in the short day plants, but no appreciable difference was noted between the plants grown under natural and long day.

Ratio:

The ratio of female to male flowers decreased markedly in the plants exposed to longer dark period which was 1:5.1, but the corresponding ratio under long day was 1:32.4.

Experiment 2b:

Seed treatment and photoperiod:

Cucumber: cv. Kalyan

Length:

Plants under long day, in general, showed marked increase in length and the linear growth was greatly enhanced by treatment with different concentrations of GA (Table-24).
Node number:

Similarly number of nodes was more in long day treated plants compared to those grown under short and natural day length. GA, not only stimulated growth under long day but also caused significant increase in node number and the lowest concentration (1 ppm) developed maximum number of nodes.

Position of first female flower:

Treatments with CCC, coumarin and GA were found to developed the first pistillate flower at lower nodes than the control plants. Seed treatment with coumarin at 1 ppm and CCC at 100 ppm developed the first female flower on a much lower node under natural and short day conditions respectively.

Female flowers:

1) Main shoot: Seed treatment with CCC at 10 ppm initiated flower in only one plant under long day. Plants grown from seeds treated at 10 and 100 ppm CCC, 100 ppm GA and different concentrations of coumarin and exposed to natural day length developed significantly increased number of female flowers on the main shoot. Under short day condition, seed treatment with 10 and 100 ppm CCC and 1 ppm coumarin developed larger number of female flowers. Treatment at 100 ppm CCC under short day increased the number of female flowers by 300 per cent over that on the untreated plants.

2) Branches: Seed treatment with CCC at 10 and 100 ppm and coumarin at 1 ppm and different concentrations of GA and exposure of these plants to natural day markedly increased the number of female flowers on the branches. Short day exposure of the plants grown from seeds treated at 10 and 100 ppm CCC and GA also increased the production of female flowers.
iii) **Total**: Under natural day different concentrations of GA and 10 and 100 ppm CCC and 1 and 10 ppm coumarin produced larger number of pistillate flowers compared to those under control. Treatment with 10 and 100 ppm CCC and 100 ppm GA under short day increased the number of female flowers by 66, 132 and 63 per cent over control.

**Male flowers**: Although, most of the treatments with the chemicals reduced maleness both on the main shoot and branches irrespective of the light periods, plants grown from GA treated seeds, in general, produced minimum number of male flowers.

**Ratio**: Seed treatment with the chemicals markedly reduced the ratio of pistillate to staminate flowers under natural and short day.

**Ridge gourd cv. Long Green**

**Length**: Seed treatment at 10 and 100 ppm CCC under natural day condition markedly reduced the length of the vines, while treatment at 100 ppm GA increased the vegetative growth of the plants irrespective of light periods (Table-25).

**Node number**: Plants grown from the seeds treated with various concentrations of GA markedly increased the node number under different photoperiods. Treatment with 100 ppm CCC and 1 ppm coumarin under short day also produced larger number of nodes.
Position of first female flowers:

All the treatments were found to be effective in developing the first female flower at lower nodes than untreated plants. Different concentrations of coumarin and CCC developed the first female flower on much lower nodes under natural and short day conditions respectively.

Female flowers:

1) Main shoot: Larger number of pistillate flowers was recorded in the plants grown from seeds treated with different concentrations of CCC and coumarin and 10 and 100 ppm GA under natural day. Treatment with coumarin at 100 ppm also produced significantly greater number of female flowers under short day. Different concentrations of CCC and GA were found to be effective in inducing female flowers on the main shoot even under long day condition.

ii) Branches: Soaking of seeds in different concentrations of coumarin, 10 and 100 ppm of CCC and GA also developed larger number of female flowers on the branches. Seed treatment at 100 ppm CCC under short day increased the number of female flowers by 70 per cent, compared to that under control.

iii) Total: As it was observed on the branches, treatment with different concentrations of coumarin and 10 and 100 ppm of CCC and GA showed increased production of female flowers under natural day. Under short day condition, 100 ppm CCC markedly increased the femaleness on the treated plants.

Male flowers:

1) Main shoot: Under short day, all the treatments reduced the
Baldness Irrespective of the nature and concentrations of the chemicals and 1 and 100 ppm of coumarin was found to be more effective in this respect. Treatment with CCC and GA also induced male flower formation on the main shoot under longer light period and GA at 10 and 100 ppm markedly enhanced the maleness.

1) Branches: Seed treatment with 1 and 10 ppm CCC, 1 and 100 ppm coumarin and 100 ppm GA under short day markedly reduced the male flower formation on the branches.

11) Total: Different concentrations of GA under natural day, markedly enhanced the maleness, while treatments with CCC and coumarin under short day suppressed the male flower formation.

Ratio:
Treatment with the chemicals markedly decreased the ratio of female to male flowers both on the main shoot and the branches under natural and short day.

Experiment 26:
Temperature treatment of seeds:

Cucumber cv. Kalvan:
Data on vegetative growth, number of female and male flowers and sex-ratio on main shoot and branches are presented in Table 26.

Length:
Plants grown from seeds treated at 40°C showed significant increase in length compared to those kept at 4°C and 15°C during germination. Seed treatment at 15°C promoted greater elongation of the vines than at 4°C.
No significant difference was, however, recorded in the number of nodes of the plants under different treatments.

**Position of first female flower:**

Seed treatment at 4°C developed the first female flower at comparatively lower node than in the other two treatments.

**Female flowers:**

Significant increase in the number of female flowers on the main shoot and branches was recorded due to seed treatment at low temperature (4°C) as compared to that under 40°C.

**Male flowers:**

Seed treatment at lower temperatures (4°C and 15°C) suppressed the formation of male flowers by 37-95 per cent compared to that obtained under 40°C.

**Ratio:**

Plants grown from seeds treated at 4°C showed marked reduction in the ratio of female to male flowers, while treatment at 40°C markedly increased the ratio.

**Lonsamelon cv. Jaspuri Long:**

Data on length of the plants, number of nodes, number of female and male flowers and sex-ratio are presented in Table 27.

**Length:** Treatment at 4°C and 40°C markedly increased the length of the plants.

**Node number:** Seed exposed at 40°C developed plants with more number of nodes than those from other treatments.

**Position of first female flower:** Seed treatment at 40°C was found
to develop first female flower at lower node compared to other treatments.

**Female flowers:**

Plants grown from seeds treated at 40°C produced 271 and 238 per cent larger number of female flowers on the main shoot and branches respectively as compared to that at 4°C. Treatment at 40°C also developed 108 and 122 per cent increased number of pistillate flowers on the main shoot and branches respectively than at 15°C.

**Male flowers:**

Seed treatment at 4° and 15°C markedly reduced the number of male flowers on the main shoot and branches.

**Ratio:**

The ratio of total number of female and male flowers decreased under 40°C treatment than the other treatments.

**Snapmelon cv. Sweet.**

Data on vegetative growth, number of female and male flowers and sex-ratio are presented in Table 28.

**Length:**

Significant increase in the length of the vines was found under 40°C. Seed treatment at 4°C also promoted length of the plants.

**Node number:**

The number of nodes markedly increased in plants grown from seeds treated at 4° and 40°C. Treatment at 15°C developed lesser number of nodes.

**Position of first female flowers:**

The lowest node number at which the first female flower appeared was found in the plants.
Female flowers:

1) Main shoot: Treatment at 4°C and 40°C increased the number of female flowers over that produced at 15°C.

2) Branches: Plants grown from seeds treated at 4°C produced 100 per cent larger number of female flowers on branches than the plants at 40°C. Seed treatment at 15°C also developed 61 per cent increased number of female flowers on the branches than at 40°C.

3) Total: Treatment at 4°C was found very effective in producing increased number of female flowers.

Male flowers:

1) Main shoot: Plants grown from seeds treated at 40°C decreased the production of male flowers on the main shoot than that produced at 4°C and 15°C.

2) Branches: Seed treatment at 4°C and 15°C suppressed the number of male flowers on the branches.

3) Total: Seed treatment at 15°C caused marked reduction in number of male flowers as compared to the other treatments.

Ratio:
The lowest and highest ratios of female to male flowers were found under 4°C and 40°C respectively.

Ridge gourd cv. Long Green:

Data on length of the plants, number of nodes and flowering on the main shoot and branches are presented in Table 29.
Length:
Both high (40°C) and low (4°C) temperature treatment of seeds caused significantly greater length than at 15°C.

Node number:
Plants grown from seeds treated at 40°C developed maximum number of nodes. Treatment at 4°C also produced increased number of nodes than 15°C treatment.

Position of first female flower:
Seed treatment at 15°C produced the first female flower at lowest node (2.0), while average node number under 4° and 40°C was 4.0 and 6.4 respectively.

Female flowers:
1) Main shoot - Treatment at 4° and 15°C produced significantly larger number of female flowers on the main shoot than at 40°C treatment.

2) Branches: Plants grown from seeds treated at 4°C developed 48 and 187 per cent more number of female flowers on the branches as compared to that produced at 15° and 40°C respectively.

3) Total: Soaking of seeds at 4° and 15°C markedly increase the number of female flowers.

Male flowers:
Treatment at 4°C showed maximum suppression in the formation of male flowers, while other two treatments did not show any appreciable difference in this respect.
The female to male flower ratio decreased under 4°C and maximum value of the ratio was obtained under 40°C.

**Bitter gourd cv. Small Green**

**Length**

Seed treatment at 15°C and 40°C significantly increased the length of the vines compared to that at 4°C (Table-30).

**Node number**

Plants grown from seeds treated at 15 and 40°C produced markedly increased the number of nodes.

**Position of first female flower**

Treatment at 4°C was very effective in developing the first female flower at lower nodes than other treatments.

**Female flowers**

i) **Main shoot**

Marked increase in female flower production was recorded under 15°C which was 85 per cent more as compared to that at 4°C. Treatment at 40°C also produced significantly increased number of female flowers than under 4°C treatment (Table-30).

ii) **Branches**

There was no significant difference in the number of female flowers produced on branches under the different treatments.

iii) **Total**

Treatment at 15°C was found most effective and developed maximum number of female flowers per plant.

**Male flowers**

Marked suppression in the formation of male flowers on the main shoot and branches was recorded in the plants grown
from seeds treated at 4°C. Seed treatment at 15°C also showed significant reduction in the male flower formation than at 40°C.

**Ratio**

Treatment at 4°C markedly decreased the ratio of female to male flowers and the reduction was mainly due to less number of male flowers. Plants under 15°C also showed lower ratio than the plants under 40°C.

**Round gourd cv. Round White**:

**Length**:

Plants grown from seeds treated at 4°C showed markedly increased length of the vines (Table 31).

**Node number**:

Significant increase in the number of nodes was recorded under 4°C treatment over that at 15° and 40°C and also under 15°C over that at 40°C.

**Position of first female flower**:

Plants under 4°C developed the first female flower at comparatively lower nodes than other treatments.

**Female flowers**:

Treatment of seeds at low temperature (4°C) increased the femaleness on the main shoot and branches of the plants. Pretreatment of seeds at 4°C enhanced the production female flowers by 24 and 62 per cent than at 15° and 40°C respectively.

**Male flowers**:

1) **Main shoot** - Treatment at 4°C developed markedly reduced number of male flowers on the main stem, while treatment at
40°C increased the number of male flowers on the main shoot by 35 and 134 per cent over that at 15° and 4°C respectively.

ii) Branches - Treatment at 4°C showed markedly reduced number of male flowers on branches.

iii) Total - As observed on the main shoot, treatment at 4°C developed markedly decreased number of male flowers per plant as compared to that at 15° and 40°C. Pretreatment of seeds at 15°C also developed decreased maleness than at 40°C.

**Ratio:**

The ratio of female to male flowers decreased on the main shoot and branches of the plants grown from seeds treated at 4°C. Treatment at 40°C, however, showed maximum value of the ratio.

**Experiment 3d:**

**Temperature treatment of seeds and photoperiod:**

**Cucumber:** cv. Kalvan

**Length:**

The data presented in Table 32 show that low temperature treatments of seeds (4° and 15°C) reduced the length of the plants irrespective of the light periods.

**Node number:**

Number of nodes also decreased significantly with lower temperatures and short day treatment developed less number of nodes compared to the other light periods.

**Position of first female flower:**

Seeds treated at 4° and 15°C developed the first female flower at lower nodes and short day exposure further enhanced the effectiveness in this respect.
Female flowers:

It is evident from the table that among the three temperature treatments the lowest temperature (4°C) produced maximum number of female flowers both under natural and short day compared to that recorded by treatment at 15°C and 40°C. Seed treatment at 15°C stimulated larger number of female flowers than obtained at 40°C. Short day condition promoted femaleness in all the plants irrespective of temperature treatments.

Male flowers:

It is also interesting to note that low temperature suppressed maleness and the effect was much more pronounced under short day than under natural day.

Ratio:

Ratio of female to male flowers decreased with seed treatment at lower temperatures and short day exposure further reduced the ratio.

Ridge gourd: cv. Long Green:

Length:

Long day treatment of plants increased the length of the vines irrespective of temperature treatment of seeds (Table 33). Seed treatment at the lowest temperature (4°C) on the other hand reduced the linear growth of the plants under the different light periods.

Node number:

Number of nodes was more on each plant in long day condition and treatment at lower temperatures (40 and 15°C) markedly decreased the node number under different light periods.
Position of first female flower:

As observed in cucumber, low temperature treatments of seeds (4°C and 15°C) developed the first female flower at lower nodes and short day exposure promoted earlier appearance of female flower.

Female flowers:

Seed treatment with lowest temperature (4°C) produced maximum number of female flowers both under natural and short day. Plants grown from seeds treated at 15°C stimulated larger number of female flowers than obtained at 40°C. Short day treatment, however, promoted femaleness in all the plants irrespective of temperature treatment of seeds.

Male flowers:

It is also evident from the data in Table 33, that low temperatures suppressed maleness both on the main shoot and the branches and lowest temperature treatment (4°C) showed maximum suppression. Short day treatments caused further suppression of maleness.

Ratio:

Pistillate to staminate flower ratio decreased under low-temperature treatments and exposure to short day further reduced the ratio.
DISCUSSION

It is evident from the results of the experiments that short day treatment has decreased the length of the vines in longmeion, snapmeion, ridge gourd, bitter gourd and round gourd. Long photoperiod, on the other hand, has increased the vegetative growth of cucumber, bitter gourd and round gourd.

Photoperiodic treatments are found to influence the sex-expression in several species of cucurbits. Under short day, the ratio for female to male flowers has decreased in all the species due to formation of larger number of pistillate flowers. It has also decreased the number of staminate flowers in ridge gourd and round gourd. Long day, on the other hand, has promoted 'maleness' in longmeion, snapmeion and bitter gourd and has also adversely affected the production of pistillate flowers in snapmeion and round gourd. The cultivars of cucumber and ridge gourd used in this experiment are found to be short day plants as they do not flower with 16 hours light.

Earlier works show that environmental factors alter sex-expression by changing the physiological condition of the plant before flower differentiation. Nitsch et al. (1962) in the experiment on $\textit{C. pepo}$, $\textit{C. sativus}$ and $\textit{C. anguria}$ have reported the morphological changes in flowers under different photoperiods and stimulation of femaleness in short day. Increased number of female flowers under short day has also been recorded by Saito (1961), Fukushima et al. (1968) and Makar (1968) in cucumber. It is likely that in addition to metabolites, photoperiod alters endogenous auxin content. Atamin and Galun (1962)
suggest that sex tendency of cucurbits is regulated mainly by the hormonal balance in the vicinity of the developing floral primordium.

Seed treatment with chemicals and exposure to short day has showed the effectiveness of different concentrations of CCC and 10 and 100 ppm GA in cucumber, 100 ppm CCC in ridge gourd in increasing the number of pistillate flowers compared to that obtained by short day or treatment with chemical alone. Treatment with coumarin at 1 ppm in cucumber and all the concentrations of the same chemical and GA at 100 ppm in ridge gourd has, on the other hand, reduced femaleness under short day. Although ridge gourd fail to flower under long day, but both staminate and pistillate flowers developed when the seeds are previously treated with different concentrations of CCC and GA. There are evidences of counteracting the adverse effects of long day on femaleness in cucurbits with the use of NAA (Ito and Saito, 1956, 1957) and high dose of nitrogen and NAA (Brantley and Warren, 1968, 1969).

Seed treatment at 4°C has increased the length of vines in round gourd but decreased the linear growth of cucumber and bitter gourd. At 15°C, however, greater elongation has been recorded in cucumber, but not in longmelon, snapmelon and ridge gourd. Plants grown from seeds treated at 40°C, on the other hand, have showed maximum length of the vines in cucumber.

Seed treatment at different temperatures has showed differential responses with regard to the development of male
and female flowers in different species of plants. Snapmelon, ridge gourd and round gourd grown from seeds vernalised at 40°C have produced increased number of female flowers. Seeds of bitter gourd and round gourd when treated at 15°C have developed larger number of female flowers. Reduction in the number of staminate flowers has also recorded in cucumber, snapmelon, ridge gourd, bitter gourd and round gourd grown from vernalised seeds at 4°C and 15°C. Kovalov (1938) suggests that nitrogenous substances appear to be resynthesised during vernalisation process and become readily available which may be responsible for increased production of female flowers as production of pistillate flowers requires more number of different amino acids in greater quantity than staminate flowers (Kashinathan et al., 1965). Leopold and Guernsey (1953) report that low temperature increases the promotive responses of auxin which may influence the sex expression of cucurbits. In the present investigation, pistillate flower formation has also increased in longamelon under 40°C. Junges (1954a, b) and Veselovskaja (1954) have also obtained higher yields of cucurbits grown from seeds treated at high temperatures (40°C-60°C).

The response to low temperatures treatment of seeds in increasing the feminenes has been further enhanced under short day, but the effect was additive because of the favourable environmental factors. Low temperature, however, has failed to alter the response to flowering due to long day. Catey (1957) has also reported that low temperature increases the responsiveness to photoperiod. Larger number of female flowers under short day is likely due to greater concentration of hormonal factors in plants raised from vernalised seeds.
SUMMARY

Effects of different photoperiod, temperature treatments of seeds, chemicals and photoperiod and temperature treatment of seed and photoperiod were studied on some species of cucurbits in order to develop a larger number of pistillate flowers. The investigation was carried out at the gardens of the Agricultural Society of India, Calcutta.

1. In the first set of experiments (Expt. 2a) seedlings of cucumber, long melon, snap melon, ridge gourd, bitter gourd and round gourd were exposed to long day (16 hours light), short day (8 hours light) and natural day (between 12 hrs. 4 min. to 12 hrs. 10 mins.) from germination up to 15 days after the appearance of first flower.

   Short day treatment decreased the female to male flower ratio in all the six species taken for the experiment by increasing the number of pistillate flowers in cucumber, long melon, snap melon, ridge gourd and bitter gourd. Exposure of plants to short day also decreased the production of staminate flowers in ridge gourd and round gourd. Long day treatment failed to produce flower in cucumber and ridge gourd.

2. In the second set of experiments (Expt. 2b) seeds of cucumber and ridge gourd were soaked in 1, 10 and 100 ppm of CCC, coumarin and GA for 48 hours and sown in pots. The seedlings were then exposed to different light periods/mentioned in Expt. 2a.
Seed treatment with 10 and 100 ppm of CCC and GA in cucumber and 100 ppm CCC in ridge gourd markedly increased the formation of pistillate flowers under short day. Treatment with 100 ppm CCC in cucumber and different concentrations of CCC and GA in ridge gourd stimulated flowering even under long day.

In another set of experiments (Expt. 2c), seeds of cucumber, longmelon, snapmelon, ridge gourd, bitter gourd and round gourd were soaked in water and kept at 3 different temperatures - 4°C, 15°C and 40°C for 96 hours in dark. The germinated seeds were sown in field.

Seed treatment at 4°C markedly decreased the female to male flower ratio in all the species except longmelon with increased production of female flowers in cucumber, snapmelon, ridge gourd and round gourd. Low temperature treatment (40°C) also reduced male flower formation in cucumber, ridge gourd, bitter gourd and round gourd. Seed treatment at 15°C also showed reduced female to male flower ratio in most of the species by increasing pistillate flowers in bitter gourd and round gourd and decreasing the number of staminate flowers in cucumber, snapmelon and round gourd. In longmelon, plants grown from seeds treated at 40°C, however, developed maximum number of pistillate flowers.

In the fourth set of experiments (Expt. 2d) soaked seeds of cucumber and ridge gourd were treated at three temperatures as mentioned in Expt. 2c and then sown in pots. The seedlings obtained from each temperature treatment were exposed to long day, short day and natural day.
Exposure to short day increased the effectiveness of vernalisation at low temperatures (4° and 15°C) in cucumber and ridge gourd and developed larger number of female flowers. Adverse effect of high temperature treatment of seeds (40°C) on female flower production was counteracted when the plants were exposed to short day.
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