RESEARCH PAPER:

Effect of colchicine on cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.]

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SUMMARY

Experiment was carried out to study the effect of colchicine on seedling growth, vegetative and yield parameters of cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.]. Colchicine increased the root length and shoot length significantly in all the concentrations used. The number of lateral roots increased very significantly at 10 ppm, 15 ppm, 20 ppm and 25 ppm and significantly at 5 ppm. Colchicine treatment on the 40th day increased the epicotyl length significantly at 5ppm and very significantly at all concentrations . Hypocotyl length increased significantly at 10 ppm and 15 ppm and very significantly at 20 ppm and 25 ppm. Regarding the root length, a significant increase was seen at 10ppm and very significant increase at all the rest concentrations. Internodal length, petiole length and number of lateral roots increased very all the concentrations. In contrast to colchicine treated vegetative parts, the pod character like pod circumference, pod length and pod weight decreased in all the concentrations. Regarding the pod length and pod weight a very significant reduction was noted at 15 ppm, 20 ppm and 25 ppm. The number of seeds/pod decreased at 5 ppm, 10 ppm, 15 ppm and 20 ppm and increased at 25 ppm. Weight of seeds/pod increased at 5 ppm, 10 ppm and 15 ppm and decreased very significantly at 20 ppm and 25 ppm. Thus, in conclusion, colchicine increased the vegetative parameters like root length, shoot length, epicotyl length, hypocotyl length, petiole length, internodal length and number of lateral roots.

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Key Words :
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Protein nutrition is one of the most crucial problems in India. Majority of Indians are vegetarian and pulses form an important constituent in the diet. Due to their nutritional value comparative to meat, pulses make an important component of vegetarian diet.

Cluster bean [*Cyamopsis tetragonolobus* (L.) Taub.] is one of the important major pulse crops in India. It is an annual, erect, self-pollinated pulse crop. It is also cultivated for hay, silage and green manure. Raw mature seeds contain 23 per cent protein. 1.7 per cent fat, 6 per cent carbohydrate and traces of vitamins and minerals.

Colchicine is obtained from the corm and seeds of autumn crocus (*Colchicum autumnale*), a member of the Lily family. In high concentration this drugs is extremely toxic, but at low concentration and with proper length of exposure, it has been shown to cause chromosome doubling in a number of plants. The spindle fibres do not develop during normal mitosis, as a result the chromosomes fail to separate at metaphase. A new cell wall does not ... and a single cell with two chromosomes sets results.

Plant breeders are aware of the need for diverse genotypes to meet the demands of current and future plant breeding programmes. Hence, induced mutations can be used profitably to generate useful variation for qualitative and quantitative fruits and therefore it provides an alternate to natural variation.

Therefore, in the present study, an attempt has been made to understand the effect of colchicine in cluster beans.

EXPERIMENTAL METHODOLOGY

Seeds of cluster bean *[Cyamopsis tetragonolobus* (L.) Taub.] purchased from the Seed Centre, Agriculture University, Coimbatore were used for the investigations. Seeds of cluster beans were sown in experimental plots of Avinashilingam Deemed University. Three sets of experiments were conducted.

Experiment I:

For evaluating the rate of seedling growth, the seeds were germinated in germination towels. For the experiments, the seeds were surface sterilized in 0.1 per cent mercuric chloride for 1 to 2 minutes and rinsed thrice in distilled water.

Experiment II:

For studying the various morphometric characters during the mid-vegetative period of growth, the seeds were sown in pots and the characters were statistically analyzed.

Experiment III:

The seeds were sown in statistically designed randomized compact blocks in the research field in Avinashilingam Deemed University and the investigation on pods and seeds were carried out.

The sterilized seeds were soaked in beakers containing equal amounts of different concentrations of colchicine (5 ppm, 10 ppm, 15 ppm, 20 ppm and 25 ppm) One set was kept as control by soaking the seeds in distilled water. After 24 hours, the solution was decanted and the seeds were arranged in germination towels. On the 7th day, root length, shoot length and the number of lateral roots formed were recorded.

On the 40th day, the plants were uprooted from the pots. The following parameters were recorded - epicotyl length, hypocotyl length, root length, number of leaves/plant, internodal length, petiole length and number of lateral roots/plant.

The seeds were sown in field and 20 pods were collected at random from each concentration. Pod circumference, pod length, pod weight, number of seeds/pod and weight of seeds/pod were studied.

EXPERIMENTAL FINDINGS AND DISCUSSION

The effect of colchicine on *[Cyamopsis tetragonoloba* (L.) Taub.] was assessed by studying the following morphological traits. Three sets of experiments were conducted. On the 7th day, the parameters like root length, shoot length and the number of lateral roots were recorded. On the 40th day, the parameters like length of epicotyl, length of hypocotyl, root length, number of leaves/plant, intermodal length, petiole length and the number of the lateral roots/plant were analyzed. At the end of season, 20 matured pods were collected from each concentration and traits like pod circumference, pod length, pod weight, number of seeds/pod and weight of seeds/pod were noted. The results were presented in Table 1-3. Three sets of experiments were conducted.

Table 1 : Effect of colchicine on early seedling growth (7days)

Characters	Control	5 ppm	10 ppm	15 ppm	20 ppm	25 ppm
Root length (cm)	4.33±0.65	8.19±0.46**	8.24±0.45**	8.26±0.45**	8.86±0.35**	8.31±0.86**
Shoot length (cm)	4.42±0.47	7.05±0.33**	7.02±0.35**	7.31±0.36**	8.02±0.26**	7.88±0.58**
Number of lateral roots	2.55±0.46	4.75±0.82**	5.9±1.13**	6.1±0.87**	6.65±0.83**	6.25±1.19**

* and ** indicate significance of values at p= 0.05 and 0.01, respectively

Table 2 : Effect of colchicine on vegetative parts (40 days)

Characters	Control	5 ppm	10 ppm	15 ppm	20 ppm	25 ppm
Epicotyl length (cm)	6.45±0.37	7.59±0.32*	9.01±0.30**	8.92±0.39**	9.19±0.38**	9.92±0.38**
Hypocotyl length (cm)	5.93±0.16	6.13±0.2	6.6±0.26*	6.64±0.25*	7.75±0.32**	8.62±0.37**
Root length (cm)	4.85±0.35	5.93±0.21**	6.09±0.33*	6.24±0.35**	6.91±0.37**	7.2±0.43**
Number of leaves/plant	4.0±0.21	4.15±0.2	4.2±0.20	4.3±0.19	4.35±0.221	4.45±0.28**
Internodal length (cm)	3.75±0.17	4.62±0.24**	4.78±0.18**	4.72±0.13**	5.09±0.23**	5.27±0.16**
Petiole length (cm)	0.48±0.03	0.85±0.04**	1.01±0.05**	1.2±0.07**	1.16±0.17**	1.17±0.04**
Number of lateral roots	5.7±0.44	9.6±0.43**	8.55±0.47**	9±0.55**	10.6±0.53**	12.6±0.48**

* and ** indicate significance of values at p= 0.05 and 0.01, respectively

Table 3 : Effect of colchicine on pod and seed characters

Characters	Control	5 ppm	10 ppm	15 ppm	20 ppm	25 ppm
Pod circumference(cm)	2.22±0.42	2.41±0.08*	2.28±0.73	1.95±0.04**	1.84±0.06**	1.97±0.05**
Pod length(cm)	10.11±0.2	9.74±0.29	9.75±0.3	9.09±0.25**	6.94±0.50**	8.11±0.23**
Pod weight (g)	2.13±0.13	2.14±0.18	1.96±0.11	1.53±0.1**	1.04±0.08**	1.11±0.06**
Number of seeds/pod	6.9±0.25	6.7±0.28	6.85±0.24	6.6±0.36	6.3±0.34	7.05±0.33
Weight of seeds/pod (mg)	59.75±4.8	148.8±28.93**	109±16.81**	86.5±10.64*	39.25±5.68**	39.5±3.89**

* and ** indicate significance of values at p= 0.05 and 0.01, respectively

Experiment I:

The results of experiment I are presented in Table 1. On the 7th day, parameters like root length, shoot length and the number of lateral roots were recorded.

Root length:

A very significant increase was noted in all the concentrations than control (4.33 ± 0.65). A very significant increase in root length was noted at 5 ppm (8.19 ± 0.46), 10 ppm (8.24 ± 0.45), 15 ppm (8.26 ± 0.45), 20 ppm (8.86 ± 0.35) and 25 ppm (8.31 ± 0.86). The result is in agreement with the result of Mehetre *et al.* (2003) in cotton plant.

Shoot length:

Regarding the shoot length a very significant increase was noted at 5 ppm (7.05 ± 0.33), 10 ppm (7.02 ± 0.35), 15 ppm 97.31 ± 0.36), 20 ppm (8.02 ± 0.26) and 25 ppm (7.88 ± 0.58) than the control (4.42 ± 0.47).

Number of lateral roots:

The number of lateral roots was directly proportional to the concentrations used. It increased in all the concentrations used. (5 ppm, 10 ppm, 15 ppm, 20 ppm and 25 ppm). The increase was significant at 5 ppm (4.75 ± 0.82) and very significant at 10 ppm (5.9 ± 1.13), (15 ppm 96.1 ± 0.87), 20 ppm (6.65 ± 0.83) and 25 ppm (6.25 ± 1.19).

Experiment II:

The results of experiment II are presented in Table 2. The effects of colchicine on mid vegetative parts were analyzed on the 40th day, and the following parameters were recorded:

Epicotyl length:

The length of epicotyls increased in all the concentrations used and it was significant at 5 ppm (7.59 ± 0.32) and very significant at 10 ppm (9.01 ± 0.30), 15 ppm (8.92 ± 0.39), 20 ppm (9.19 ± 0.38) and 25 ppm (9.92 ± 0.38). The result is in agreement with the result of Gowacka *et al.* (2010) in *Miscanthus* spieces.

Hypocotyl length:

Regarding the hypocotyl length, significant increase was noted at 10 ppm and 15 ppm (6.6 ± 0.26) and (6.64 ± 0.25) due to colchicine treatment. A very significant increase was also noted at 20 ppm (7.75 ± 0.32) and 25 ppm (8.62 ± 0.37).

Root length:

The length of root increased rapidly and the increase was directly proportional to the concentrations used. A significant increase was noted at 10 ppm (6.09 ± 0.33) and very significant increase was noted at 5 ppm, 15 ppm, 20 ppm and 25 ppm (5.93 ± 0.21, 6.24 ± 0.35, 6.91 ± 0.37, 7.2 ± 0.43).

Number of leaves:

A slight increase was noted in the number of leaves, however the increase was not significant.

Internodal length:

A very significant increase was noted in all the concentrations of colchicine used. Internodal length increased very significantly at 5 ppm (4.62 ± 0.24), 10 ppm (4.78 ± 0.18), 15 ppm (4.72 ± 0.13), 20 ppm (5.09 ± 0.23) and 25 ppm (5.27 ± 0.16).

Petiole length:

The effect of mutagenic agent colchicine showed a very significant increase in the petiole length of cluster beans. Petiole length was very significant at all the concentrations used. At 5 ppm (0.85 ± 0.04), 10 ppm (1.01 ±0.05), 15 ppm (1.2 ±0.07), 20 ppm (1.16 ±0.17) and 25 ppm (1.17 ± 0.04) than the control (0.48 ± 0.03).

Number of lateral roots:

A very significant increase was noted at 5ppm (9.6 ± 0.43), 10ppm (8.55 ± 0.47), 15ppm (9 ± 0.55), 20ppm (10.6 ± 0.53) and 25ppm (12.6 ± 0.48) than the control (5.7 ± 0.44).

Experiment III:

The results of experiment III are presented in Table 3.

Pod circumference:

Pod circumference increased significantly at 5 ppm (2.41 ± 0.08) than the control (2.22 ± 0.42). However, it started decreasing very significantly from 15 ppm onwards.

Pod length:

Regarding the length of pod, there was a very significant change from 15 ppm to 25 ppm. The reduction in length was very significant at 15 ppm (9.09 ± 0.25), 20 ppm (6.94 ± 0.50) and 25 ppm (8.11 ± 0.23) than the control (10.11 ± 0.2).

Pod weight:

The pod weight decreased very significantly at 15 ppm, 20 ppm and 25 ppm (1.53 ± 0.1, 1.04 ± 0.08, 1.11 ± 0.06). The result is in agreement with the result of Poutaraud and Girardin (2003) in natural grassland.

Number of seeds/pod:

There was no significant change in number of seeds/pod than the control.

Weight of seeds/pod:

A very significant increase was noted at 5 ppm (148.8 ± 28.93) and 10 ppm (109 ± 16.81) and the increase was significant at 15 ppm (86.5 ± 10.64). However, at 20 ppm and 25 ppm a very significant reduction was noted than the control (59.75 ± 4.8). The results were in agreement with the findings of Mensah *et al.* (2007) in sesame (*Sesame indicum* L.).seed

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