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Growth and yield of *Brassica campestris* L. (Rapeseed) between Gibberellic acid (GA_3) and Chlorocholine chloride (CCC)

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Abstract

The test was designed to study the Growth and yield of *Brassica campestris* L. (Rapeseed) between GA_3 and Chlorocholine chloride. Chlorocholine chloride at different concentrations (50, 100, 250 and 500 μg/ml) was applied as foliar spray on the plant treated with GA_3 at varying concentrations (100, 250, 500 and 1000 μg/ml). Gibberellic acid **(**GA_3) was applied as pre-sowing seed soaking treatment. The mixed efficacy of GA_3 and Chlorocholine chloride registered superior performances in all the parameters than either of the two compounds acted alone. GA_3 (500 μg/ml) in combination with CCC (500 μg/ml) recorded better growth and yield.

Key words: GA3, CCC, *Brassica campestris* L., Growth and yield.

INTRODUCTION

Brassica campestris L. (Rapeseed) belongs to the family Brassicaceae. The plants of this family occupy the most important position in the list of daily consumable vegetable oils. It is one of the major oilseed crops of India and it contributes as a major share in the total edible oil production of the country. Among the oil seed crops, mustard ranks first with respect to acreage and production in India. The genus Brassica of the family Cruciferae has mainly three edible oil producing species, namely *Brassica napus, B. campestris*, and *B. juncea*. Mustard can be grown in rabi season thus the environmental conditions of the growing seasons may influence the seed formation and development, which ultimately affect the yield. However, detailed study on leaf area, photosynthetic rate and growth parameter of mustard variety over the growing season in India conditions has not yet been accomplished. The yields of these high yielding varieties are far behind compared to those of other rapeseed growing countries of the world.

Although several high yielding varieties have now been developed, our country has not yet been able to meet the demands of the population and is depending on imported edible oils (Saini *et al.,* 1989). The average yield of rapeseed and mustard in our country particularly in North east region of India is rather very low in comparison to its need. Insufficient production of rapeseed and mustard for our requirements is one of causes to make a way of adulteration in oils. The extent of adulteration had reached a dangerous levels in the year 1998 in causing “dropsy” (Menon, 1998).

MATERIALS AND METHODS

Healthy seeds of *Brassica campestris* L. experiment was carried out in two seasons. The seeds of the cultivars M-27, TS-29 and B-9 of *Brassica campestris* L. were used for 1st year experiment. The first year experiment was done only to select the best variety with proper information for 2nd year experiment and it was conducted under usual agricultural method in random block design with three replications. On the basis of performance, M-27 was selected for second season. In the second year healthy seeds of M-27 were soaked in solutions of GA_3 at 100, 250, 500 and 1000 μg/ml concentrations for 12 hours at room temperature and for the control seeds were soaked in sterile distilled water. The seeds were then sown in different plots in rows according to the layout of random block design which was replicated three times.

After 40 days of sowing, foliar spray was done by the growth regulators. The row to row and plant to plant spacing was maintained at 30 cm and 15 cm, respectively. Kinetin at 0.01, 0.1, 1 and 10 μg/ml, CCC at 50, 100, 250 and 500 μg/ml and Ethrel at 10, 50, 100 and 500 μg/ml on GA_3 treated plants as well as on plants without GA_3. Control samples were sprayed with sterile distilled water.

Preparation of Land

The land prepared for the experiment was cultivated and recultivated with subsequent ladderings till the desired fine tilth for the crop was obtained. Basal application of farmyard manure at recommended doses of 3 (three) tonnes/ha and recommended doses of urea, SSP (Superphosphate) MOP (Murate of potash) in the proportion 130 : 250 : 60 kg/ha respectively were applied in the field. To prevent presence of soil insects BHC 10 per cent dust were applied along with the last ploughing in proper doses. Borax at the dose of 10kg/ha was also applied along with the above fertilizer.

Three plants of each plot of each replication were tagged randomly and used for recording data on stem length (80 days), number of branches, number of leaves (at 60 days), number of pods and the means were analysed statistically. Seeds yield was calculated converting the plot area (90 cm x 60 cm) into hectare. Oil content of seeds in terms of percentage was determined by cold Extraction Method (Kartha and Sethi, 1957).

EXPERIMENTAL RESULTS

The yearwise cultivation of this experiment was to study the effect of plant growth regulators on growth and yield of *Brassica campestris* L. and so screening of cultivars under general agricultural norms for the experiments was necessary which helped in selecting a promising variety with proper information. The number of flowers, number of pods per plant, seed yield, seed index and protein content in seeds of pea of GA_3 and CCC were recorded (Table 1,2). GA_3 stimulated stem length and enhanced number of leaves, branches and pods upto the optimum range 500 µg/ml. The maximum plant height was observed with GA_3 150 ppm which was statistically at par with GA_3 100 ppm and GA_3 50 ppm. These findings are in agreement with the findings of earlier workers i.e. Saran et al. (1992); Khan et al. (2002) in mustard, Sharma and Sarma (1997) in *Raphanus sativus*. The foliar spray of CCC reduced the stem length. This present finding in reduction of stem length substantiate the earlier finding of Pandya et al. (1974) in *Brassica juncea*, Daniel et al. (1982) in rapeseed plant, Rajput et al. (1996) in Indian mustard. The retardation in plant height caused by CCC may be due to shortening of internode by decreasing cell division (Zeevart, 1966).

At maturity, plant growth regulators significantly affected yield characteristics. GA_3 upto 500 µg mL^{-1} was highly stimulatory in increasing the number of flowers and pods per plant for both the varieties. But highest number of flowers and pods were recorded at GA_3 250 µg mL^{-1} and GA_3 at 1000 µg mL^{-1} was slightly inhibitory (Table 1). On the other hand, both the varieties showed a varied response to cycocel. Cycocel, irrespective of concentrations was superior over the control in enhancing the number of flowers and pods per plant in cv.

Azad-P-1 while in cv. Aparna 1000 µg mL^{-1} was inhibitory (Table 2). Santes and Garcia (1995) reported that GA_3 controls the pod development in pea. Goto and Pharis (1999) reported that Gas not only act to normalise plant height but also stimulates development of floral organs. Cycocel increased number and length of siliqua in Indian mustard was also reported.

Seed index gradually increased with the treatment of GA_3 upto 250 µg mL^{-1} and then declined in both the varieties. At 250 µg mL^{-1} of GA_3 the seed index was recorded as 23.05 and 23.35g in cv. Aparna and cv. Azad-P-1, respectively (Table 1). On the other hand, 250 and 500 µg mL^{-1} of cycocel were emerged as the best concentration in cv. Aparna and cv. Azad-P-1, respectively recording seed index 23.41 and 23.37 g accordingly. One value at 250 and one from 500 µg mL^{-1} which are considered here (Table 2). The results are in conformity with some earlier reports by Bora *et al*. (2003) and Prasad and Prasad (1994).

Present study clearly indicated that PGRs have the potentiality to increase the yield of pea in both the varieties. The highest yield was recorded as 13.79 and 14.05 q ha^{-1} at 250 µg mL^{-1} of GA_3 as against 11.77 and 11.16 q ha^{-1} at the control in cv. Aparna and cv. Azad-P-1, respectively (Table 1). At this concentration number of branches, pods per plant and seed index were also highest. Hence, yield increased as a manifestation of increased number of branches and pods per plant along with seed index. Different concentration of cycocel differed significantly in their inherent characters to produce yield per hactre. Cycocel increased the yield upto 250 µg mL^{-1} (14.15 q ha^{-1}) and 100 µg mL^{-1} (13.53 q ha^{-1}) in cv. Aparna and cv. Azad-P-1, respectively (Table 2). The increased in **seed yield** might be due to increase in number of branches and pods per plant.

Among the plant growth processes, seed germination and early seedling growth are considered critical for raising a successful crop as these indirectly determine the yield of the resultant crop (Gelmond, 1978). GA_3 enhanced the yield by better utilisation of photosynthates and metabolic machinery was also reported (Khan *et al*., 2002). Growth regulators increase the actual productivity when the plant growth is stimulated or the photosynthates are diverted to the harvested products (Setia and Setia, 1990). Also the **seed production** is the culmination of a number of developmental phases requiring specific nutrients to maintain the metabolic status of the flowering and seed development stages (Bhatt and Mishra, 2001). The increase in shoot length due to GA_3 treatment led to bear more leaves and thus better chance to trap more sunlight and produce more **dry matter** (Khan *et al*., 2002). The increase in yield in GA_3 treated plants in the present investigation corroborates such findings.

Growth regulators also caused an increase on protein content in the seeds. Irrespective of concentrations tried, the protein content increased with the application of GA_3 and cycocel. GA_3 at 250 µg mL^{-1} and cycocel at 500 µg mL^{-1} emerged as best concentrations in enhancing the protein content in seeds of pea in both varieties (Table 1 and 2).

Table 1: Effect of GA_3 on number of flowers, number of pods per plant, seed yield, seed index and protein content in seeds of pea

GA_3 conc. (µg mL^{-1})	No. of flowers $plant^{-1}$		No. of pods $plant^{-1}$		Seed yield (q ha^{-1})		Seed index (g)		Protein (%)	
	cv. Aparna	cv. Azad-P-1	cv. Aparna	cv. Azad-P-1	cv. Aparna	cv. Azad-P-1	cv. Aparna	cv. Azad-P-1	cv. Aparna	cv. Azad-P-1
0	17.25	17.33	17.20	17.10	11.77	11.16	21.64	22.04	21.84	21.61
10	17.38	17.50	17.33	17.23	12.32	11.20	21.76	22.10	22.44	22.20
100	19.41	19.52	19.37	19.30	13.29	13.00	2.51	23.22	27.75	27.67
250	21.83	21.93	21.73	21.79	13.79	14.05	23.05	23.35	28.90	28.90
500	17.96	17.19	17.92	17.83	11.97	11.17	22.29	22.31	24.76	24.76
1000	16.70	16.77	16.65	16.58	11.78	10.40	20.79	21.93	22.27	23.88

Table 2: Effect of Cycocel on number of flowers, number of pods per plant, seed yield, seed index and protein content in seeds of pea

Cycocel conc. (µg mL^{-1})	No. of flowers $plant^{-1}$		No. of pods $plant^{-1}$		Seed yield (q ha^{-1})		Seed index (g)		Protein (%)	
	cv. Aparna	cv. Azad-P-1	cv. Aparna	cv. Azad-P-1	cv. Aparna	cv. Azad-P-1	cv. Aparna	cv. Azad-P-1	cv. Aparna	cv. Azad-P-1
0	17.25	17.20	17.20	17.10	11.76	11.16	21.85	22.04	21.93	21.61
10	17.33	17.34	17.27	17.17	12.31	11.50	22.06	22.07	22.28	22.00
100	19.32	19.30	19.26	19.23	13.19	13.53	23.04	22.99	23.73	22.28
250	22.07	18.60	22.02	18.43	14.15	11.72	23.41	23.30	25.83	23.73
500	20.94	18.49	20.88	18.37	12.56	11.50	23.14	23.37	26.01	25.83
1000	17.23	18.25	17.11	18.03	11.47	10.90	22.68	21.52	24.55	24.55

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