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Effect of growth retardants on yield and yield parameters of mustard (*Brassica juncea* (L.) czern & cross)

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Abstract
The present investigation undertaken at field No. 04 at Agronomy Farm, S.K.N. College of Agriculture, Jobner. The experiment was conducted on one genotype in randomized block design with three replications and seven treatments. The genotype of *Brassica juncea* namely pusa jay kisan (Bio-902) were grown under rainfed condition. It is revealed from the data that the days to 50 per cent flowering decreased significantly with cycocel and mepiquat chloride. The days to 50 per cent flowering was minimum with CCC-250 ppm (56.35) closely followed by MC-250 ppm (56.60). Result further showed that under rainfed condition treatment CCC-750 ppm recorded the maximum number of siliquae per plant (240.20), number of seeds per siliqua (20.50), test weight (6.15 g), seed yield (667.25 kg/ha), biological yield and oil yield (267.56 kg/ha). The non-significant difference was observed between CCC-750 ppm and CCC-500 ppm. The harvest index shows non significantly difference among different treatment. Although the maximum harvest index was reported with CCC-500 ppm.

Keywords: siliquae, siliqua, CCC-750, CCC-500 and yield

Introduction
Mustard (*Brassica juncea* (L.) Czern & Cross) is an important *rabi* oilseed crop which belongs to family Cruciferae (Brassicaceae) and genus *Brassica*. Indian mustard or brown mustard is natural amphidiploids having chromosome no. (2n=36) with its origin place is China. It is self-pollinated crop but certain amount of cross pollination (2-15%) occurs due to insect and other factors. India is a key player in the global oilseeds scenario with 12-15 per cent of oilseeds area, 6-7 per cent of vegetable oil production, 9-11 per cent of the total edible oil consumption and 14 per cent of vegetable oil imports. In recent years a new class of organic chemicals has appeared with the special characteristics that they can retard or defer growth processes in plants, and those were termed growth retarding chemicals or growth retardants (Cathey, 1964) [1]. Growth retardants are known to reduce the intermodal growth, reducing the plant height and thereby influence the source sink relationship and stimulate the translocation of photosynthates toward sink. The growth retardants cycocel and mepiquet chloride were more beneficial in terms of the translocation of photo assimilates towards developing reproductive parts compared to growth promoter (Pankaj Kumar *et al.*, 2006) [4]. Application of growth retardants may also enhance the chlorophyll contents of leaves which help to increase the functional life of source for a longer period leading to improved partitioning efficiency and increased productivity. Reduced plant height and increase in the functional life of source for a longer period especially during grain filling stage in mustard is essential for its higher productivity. Keeping all these things in view the present study has been under taken.

Materials and Methods
The experiment was conducted on field No. 04 at Agronomy Farm, S.K.N. College of Agriculture, Jobner. Geographically, Jobner is situated 45 km west of Jaipur at 26° 05' North latitude, 75° 28' East longitude and at an altitude of 427 metres above mean sea level. The area falls in agro climatic zone-IIIA (Semi-arid Eastern Plain Zone) of Rajasthan. The climate of this region is typically semi-arid which is characterized by the aridity and extremity of temperature fluctuations in summer and winter. During summer, maximum temperature ranges between 35-46°C while in winter, it may falls down to as low as -1°C. The average rainfall of this locality is approximately 400 mm, most of which is received during rainy season from July to September.

The experiment was conducted on one genotype in randomized block design with three replications and seven treatments. The following genotype of *Brassica juncea* namely pusa jay kisan (Bio-902) were grown under rainfed condition.

Treatments
Control
CCC-250 ppm
CCC-500 ppm
CCC-750 ppm
MC-250 ppm
MC-500 ppm
MC-750 ppm
The experimental data recorded for growth, yield and other characters were statistically analysed by Panse and Sukhatme (1954). Appropriate standard error for each of the factor was worked out. Significance of differences among treatment effects was tested by "F" test. Critical difference (CD) was worked out wherever the difference was found to be significant at 5 or 1 per cent level of significance.

Results and Discussion
Days to 50 per cent flowering
Data presented in Table 1 shows the effect of different concentrations of cycocel and mepiquat chloride on day to 50 per cent flowering under rainfed condition. The day to 50 per cent flowering decreased significantly with cycocel and mepiquat chloride. The days to 50 per cent flowering was minimum with CCC-250 ppm (56.35) closely followed by MC-250 ppm (56.60). This reduction in days to 50 per cent flowering with cycocel and mepiquat chloride indicate that they may cause some metabolic changes in the plant causing conservation form vegetative phase to reproduction phase.

Number of siliquae per plant
Data presented in Table 1 shows the effect of different concentration of cycocel and mepiquat chloride on number of siliquae per plant under rainfed condition. The number of siliquae per plant increased significantly with cycocel and mepiquat chloride.
Result showed that under rainfed condition although treatment CCC-750 ppm recorded the maximum number siliquae per plant (240.20). The non-significant difference was observed between CCC-750 ppm and CCC-500 ppm. Although highest no. of siliquae per plant was recorded with MC-750 ppm (227.80) non-significant difference was recorded between MC-500 ppm and MC-750 ppm.

Table 1

Treatments	Days to 50 % Flowering	No. of Siliquae per Plant	Number of seeds per siliqua	Test weight (g)	Seed yield (kg/ha)	Biological Yield (kg/ha)	Harvest index (%)	Oil content (%)	Oil yield (kg/ha)
Control	64.85	219.80	13.50	5.00	568.25	1769.00	32.11	34.50	196.04
CCC-250 ppm	56.35	220.60	14.00	5.75	636.00	1938.00	32.83	35.20	223.87
CCC-500 ppm	59.65	229.80	14.40	5.82	661.00	2017.75	33.04	37.90	250.51
CCC-750 ppm	63.50	240.20	20.50	6.15	667.25	2099.00	32.08	40.10	267.56
MC-250 ppm	56.60	224.20	13.80	5.78	617.00	1951.75	31.65	35.30	217.80
MC-500 ppm	57.90	225.60	14.80	5.85	625.75	1975.50	30.48	37.40	234.03
MC-750 ppm	59.75	227.80	19.40	5.92	663.75	2084.75	31.84	39.70	263.50
CD (p=0.05)	6.07	17.60	1.56	0.63	46.36	204.62	NS	3.82	23.37

Number of seeds per siliqua
Data presented in Table 1 shows the effect of different concentrations of cycocel and mepiquat chloride on number of seeds per siliqua under rainfed condition. The number of seeds per siliqua increased significantly with cycocel and mepiquat chloride. Under rainfed condition treatment CCC-750 ppm recorded the maximum number of seeds per siliqua (20.50) closely followed by MC-750 ppm (19.40) and MC-500 ppm (14.80).

Test weight
Data presented in Table 1 shows the effect of different concentrations of cycocel and mepiquat chloride on test weight under rainfed condition. The test weight increased significantly with cycocel and mepiquat chloride.
Result further showed that under rainfed condition treatment CCC-750 ppm recorded highest test weight (6.15g) non-significant difference was observed between CCC-500 and 750 ppm in case of mepiquat chloride although highest test weight was recorded with 750 ppm but non-significant difference was observed between MC-500 ppm and 750 ppm.

Seed yield
Data presented in Table 1 shows the effect of different concentrations of cycocel and mepiquat chloride on seed yield under rainfed condition. The seed yield increased significantly with cycocel and mepiquat chloride.
Result further showed that seed yield increased significantly with CCC- 750 ppm (667.25 kg/ha). Non-significant differences were observed between different concentration of cycocel. In case of MC the highest seed yield was observed with MC-750 ppm. Non-significant difference was observed between different concentration of mepiquat chloride. It is in close conformity with Grewal *et al*., (1993) [2].

Biological yield
Data presented in Table 1 shows the effect of different concentrations of cycocel and mepiquat chloride on biological yield under rainfed condition. The biological yield increased significantly with cycocel and mepiquat chloride.
Result further showed that the maximum biological yield was recorded with CCC-750 ppm closely followed by MC-750 ppm. Although the increase in biological yield with MC-750 ppm was non-significant when compared with control.

Harvest index
Data presented in Table 1 shows the effect of different concentrations of cycocel and mepiquat chloride on harvest index under rainfed condition. The harvest index shows non significantly difference among different treatment. Although the maximum harvest index was reported with CCC-500 ppm.

Oil yield
Data presented in Table 1 shows the effect of different concentrations of cycocel and mepiquat chloride on oil yield under rainfed condition. The oil yield increased significantly

with cycocel and mepiquat chloride. Under rainfed condition treatment CCC-750 ppm recorded the maximum oil yield (267.56 kg/ha) closely followed by MC-750 ppm (263.50 kg/ha) as compared to control. Increase yield may be attributed to higher dry matter production and its accumulation of in reproductive parts, higher specific leaf weight and enhanced chlorophyll content or all these parameters show that significant positive correlated with seed yield (Jeyakumar and Thangaraj, 1998) [3].

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