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MORPHOLOGICAL IMPACT OF DIFFERENT DOSES OF CADMIUM ON *BRASSICA JUNCEA* DURING TIMELY SOWING AND LATE SOWING

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ABSTRACT

A pot experiment was conducted to study the effect of different doses of Lead on Brassica juncea plant. Cadmium was applied as cadmium chloride into the soil at 10 ppm, 20 ppm and 50 ppm dose. The results showed that at 30 and 60 DAS late sowing plants showed more height and root length but 90 DAS timely sowing had more height and root length. Early flowering and pod formation was found in late sowing plants.

KEY WORDS

Brassica juncea, Dose, Lead, Morphology.

INTRODUCTION

Brassica juncea plant is 140- 150 cm in height with semi compact growth. Flowers are cruciferous with yellow petals.

The crop matures in 130- 145 days and yields 23- 25 q/ha (http://agridept.cg.gov.in/agriculture/seedcerti_variety/seed_R_V_Mustard.htm). The seed yields the most important edible oil, which is the main cooking medium in Northern India and the leaves of young plants are used as green vegetables. Rapid growth in population and massive industrialization has resulted in pollution of biosphere with toxic heavy metals. Heavy metals are metals and metalloids which are toxic at low concentration. e.g., Lead, Nickel, Cadmium, Mercury, Zinc etc. Cadmium dispersed into the environment through the air by mining, smelting, usage of phosphate fertilizers, presence in sewage sludge and various industrial uses such as NiCd batteries, plating, pigments and plastics (http://www.atsdr.cdc.gov/csem/csem.asp?csem=6&po=5). Other sources of Cd are active and passive smoking of cigarettes, burning of fossil fuels etc (http://www.gov.mb.ca/health/publichealth/environmentalhealth/cadmium.html). Cd also reported in in bathing soap, shampoo, shaving cream and talcum powder [1].

Raziuddin et.al., (2011) studied Effects of cadmium and salinity on growth and photosynthesis parameters of *Brassica* species was studied and found that Cd and NaCl decreased growth of plants by reducing root and shoot fresh and dry weights, number of leaves, chlorophyll content and photosynthesis in both *Brassica napus* and *Brassica juncea* [2]. Bhardwaj et.al., (2009) determined that At high concentration of Cd (i.e. 3 g/kg) germination was completely inhibited, gradual decrease in plant height, root length, seedling biomass, fresh and dry weight, starch content, sugar content was reported [3].

At lower concentrations of Cd and Pb there was an increase in growth, pigment content, proline, protein and sugar content but at higher concentrations (30 and 40 mg/lt) negative effects were observed. Cd accumulated more than Pb in *L. polyrrhiza* [4]. It was also found that at higher concentration of Cd (40 and 50 ppm respectively) there was delayed seed germination, stunted growth, and adverse effect on root and shoot growth was observed [5]. *Brassica* species is considered to be good hyperaccumulator and is effective in the removal of Cd, Pb, Cr, Ni etc,

from soil [6]. The species has also been reported to reduce leaching of heavy metals from soil by over 98%. *Brassica juncea* (Indian mustard), a high biomass plant that can accumulate Pb, Cr, Cd, Cu, Ni, Zn, Sr, B, and Se [7].

Material and Method:

Plant species: *Brassica juncea.*

Dose of Cd: 10 ppm, 20 ppm and 50 ppm into the soil using $CdCl_2$.

Sampling: Plants were sampled for morphological parameters after every 30 days from sowing day.

Sowing time: 13 October (Timely sowing- TS) and 25 November 2010 (Late sowing- LS)

The experiment was conducted during October and November month 2010- 2011 in the Medicinal Plant Garden of SOS in Botany, Jiwaji University Gwalior, MP. Well drained 10 kg soil from a depth of 25 cm was filled into each plastic pot. Each pot was artificially contaminated with lead nitrate $CdCl_2$ for three doses of Cd- 10, 20 & 50 ppm. A control pot was also maintained. The treatment schedule contained *Brassica juncea* (cv. Pusa Bold) plants. Each treatment was replicated three times. Urea, Potassium chloride and Calcium sulphates were applied at 120, 83 and 70 mg/kg of soil respectively. DAP (diammonium phosphate) was applied at pre-flowering stage. Water was given 50 ml/kg of soil twice in a week. Plants were sampled for morphological study like height of plant, root length, flowering time and pod formation.

I Sampling: 30 DAS

II Sampling: 60 DAS

III Sampling: Harvest

Results and discussion:

In TS, height of control plants was 15.16 cm, which reduced to 14.66 cm at 10 ppm dose. At 20 ppm dose height was 15.66 cm and 14.00 cm at 50 ppm dose. In LS, the height of control plants was 31.40 cm. At 10 ppm dose it was 29.41 cm. At 20 ppm dose, height was 28.37 cm and at 50 ppm dose it was 21.75 cm. The minimum plant height for both timely sowing and late sowing plants was at 50 ppm dose. At 60 DAS in TS the height of plants in control plants was 48.48 cm. It was more for 10 ppm dose i.e., 60.37 cm. At 20 ppm dose, height decreased to 56.40 cm and to 40.73 cm at 50 ppm dose. In LS the height of control plants was 88.48 cm. At 10 ppm dose the height was more i.e. 111.72 cm. At 20 ppm dose, the height reduced to 96.43 cm and to 74.71 cm at 50 ppm dose. The height of late sowing plants was more as compared to timely sowing plants for respective treatments. The maximum height was observed at 10 ppm dose and minimum at 50 ppm dose. At 90 DAS, the height of control treatments plants was 148.45 cm and was 153.75 cm at 10 ppm dose. At 20 ppm dose, the height was 145.73 cm and at 50 ppm dose it was least i.e. 125.41 cm. In LS, the height of control plants was 122.36 cm and was 128.77 cm at 10 ppm dose. At 20 ppm dose, height was 123.41 cm and 105.83 cm at 50 ppm dose. LS plants had greater height as compared to TS plants for all treatments at 30 and 60 DAS. TS plants had greater height as compared to LS plants for all treatments at 90 DAS. At higher dose of Cd i.e., 50 ppm the height of plants was minimum (**Table- 1, Graph- 1**).

At 30 DAS, the root length of control TS plants was 12.44 cm. It was greater i.e. at 10 ppm dose it was 14.75 cm and at 20 ppm dose it was 15.29 cm. At 50 ppm dose the root length was 10 .25 cm (Table- 2, Graph- 2).In LS control plants the root length was 11.73 cm. At 10 ppm dose it was 13.84 cm and at 20 ppm dose, the length was 15.21 cm. The root length was only 9.84 cm at 50 ppm dose. At 60 DAS, the root length of control plants was 23.28 cm and for 10 ppm dose it was 26.73 cm. At 20 ppm dose, root length was 26.85 cm and at 50 ppm dose it was 19.51 cm. In control LS plants the root length was 24.62 cm. At 10 ppm dose it was 27.58 cm and at 20 ppm dose the length was 28.75 cm. At 50 ppm dose, the root length was minimum i.e., 21.83 cm. The root length for timely sowing and late sowing plants for all treatments also had very little difference. At higher dose of cadmium i.e., at 50 ppm the root length was minimum both for timely sowing and late sowing plants. At 90 DAS, the root length of TS control plants was 34.35 cm. It was more i.e., 38.92 cm at 10 ppm dose. At 20 ppm dose, the length was even more i.e., 39.56 cm, but at 50 ppm dose it decreased to 32.56 cm. The root length of control LS plants was 33.37 cm. At 10 ppm dose the root length was greater i.e., 35.81 cm. At 20 ppm dose, root length was 35.74 cm and at 50 ppm dose it was only 30.28 cm. At 30, 60 and 90 DAS the root length for all treatment had very little difference. For 50 ppm dose the root length was minimum (**Table- 2, Graph- 2**).

Table 1: Height (cm) of *Brassica juncea* var. Pusa Bold plants					
Plant sampling		Control	Height of plant at different doses of Cd		
			10 ppm	20 ppm	50 ppm
30 DAS	TS	15.16± 1.55	14.66± 1.11	15.66± 1.44	14.00± 1.20
	LS	31.40± 1.60	29.41± 2.94	28.37± 1.16	21.75± 1.50
60 DAS	TS	48.48 ± 2.68	60.37± 3.58	56.40± 4.06	40.73 ± 2.02
	LS	88.48 ±2.04	111.72±4.51	96.43± 3.37	74.71± 3.47
90 DAS	TS	148.45± 5.03	153.75±5.82	145.73± 4.50	125.41±5.06
	LS	122.36± 3.42	128.77±4.84	123.41± 5.05	105.83±4.21

Graph 2: Height (cm) of *Brassica juncea* var. Pusa Bold plants

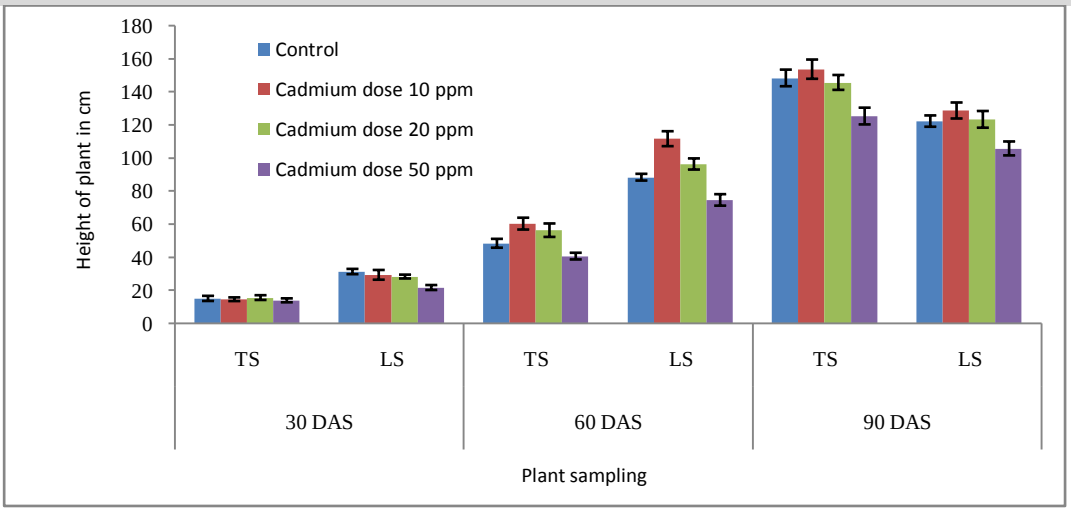


Table 2: Root length (cm) of *Brassica juncea* var. Pusa Bold plants					
Plant sampling		Control	Root length at different doses of Cd		
			10 ppm	20 ppm	50 ppm
30 DAS	TS	12.44 ± 1.25	14.75± 1.16	15.29± 1.26	10.25 ± 1.27
	LS	11.73 ± 1.07	13.84 ± 0.94	15.21± 1.05	9.84± 0.82
60 DAS	TS	23.28 ± 2.31	26.73± 1.72	26.85 ± 1.62	19.51± 1.05
	LS	24.62± 2.45	27.58± 1.19	28.75 ± 1.37	21.83 ± 1.60
90 DAS	TS	34.35 ± 1.47	38.92± 1.85	39.56± 2.26	32.62± 2.07
	LS	33.77 ± 2.22	35.81± 1.91	35.74 ± 1.69	30.28± 2.34

Graph 2: Root length (cm) of *Brassica juncea* var. Pusa Bold plants

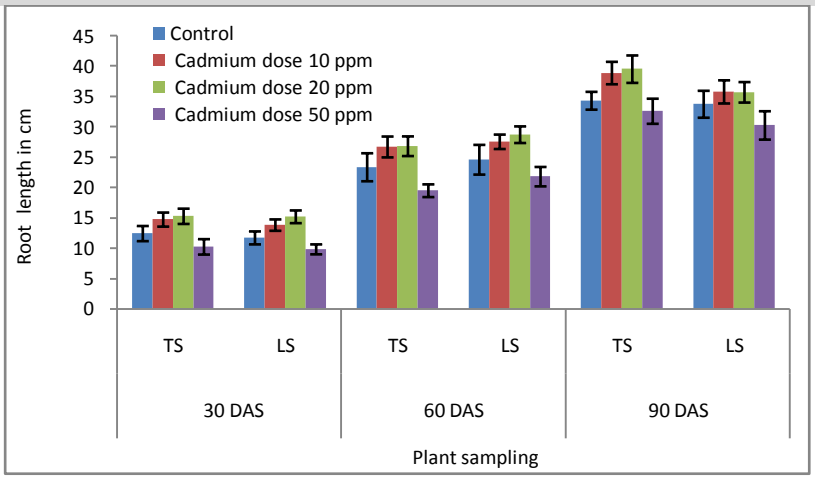


Table 3: Flowering time (days) of *Brassica juncea* var. Pusa Bold plants

Plant sampling	Control	Flowering Time at different doses of Cd		
		10 ppm	20 ppm	50 ppm
TS	65.66 ± 1.77	64.33± 2.44	64.66 ± 2.88	70.33± 1.55
LS	54.33± 2.22	56.33± 2.88	56.66± 3.11	63.33± 2.44

Graph 3: Flowering time of *Brassica juncea* var. Pusa Bold plants

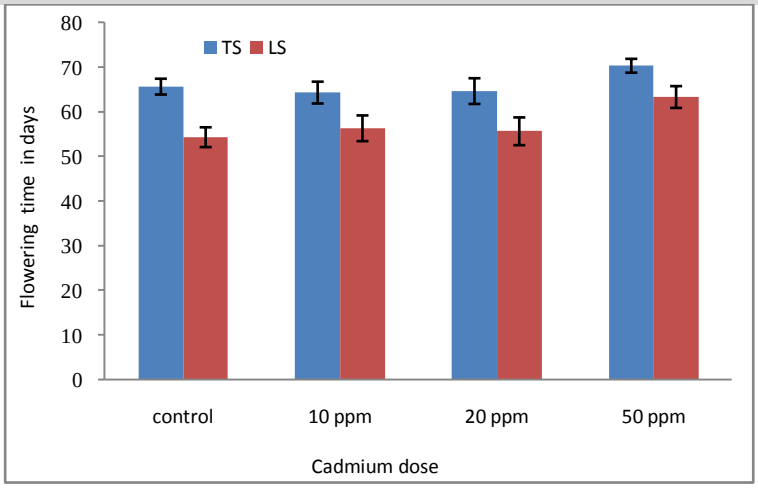
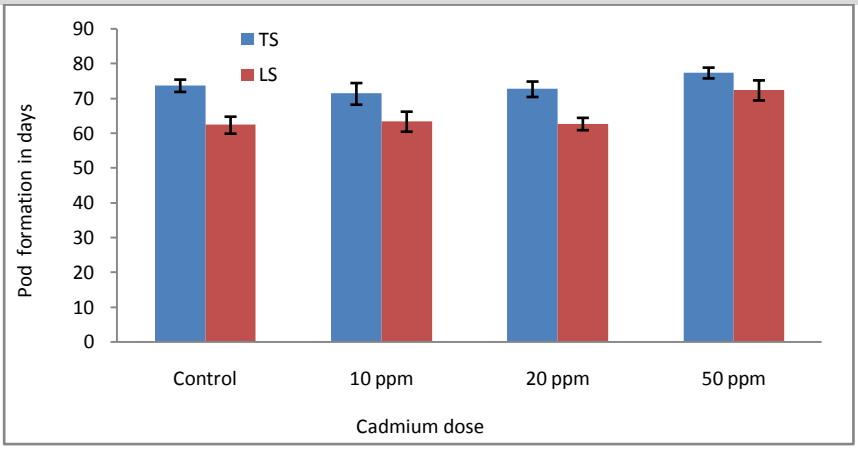


Table 4: Pod formation (days) of *Brassica juncea* var. Pusa Bold plants

Plant sampling	Control	Pod Formation at different doses of Cd		
		10 ppm	20 ppm	50 ppm
TS	73.66 ± 1.77	71.33 ± 3.11	72.66± 2.22	77.33± 1.55
LS	62.33 ± 2.44	63.33 ± 2.88	62.66± 1.77	72.33± 2.88

Graph 4: Pod formation of *Brassica juncea* var. Pusa Bold plants



In control TS plants the flowering time was 65.66 days whereas flowering time at 10 ppm and 20 ppm dose was same i.e. 64.66 days. The flowering time increased to 70.33 days at 50 ppm dose. The flowering time of control LS plants was 54.33 days. At 10 ppm and 20 ppm dose the time was almost same i.e. 56.33 days at 10 ppm and 56.66 days at 20 ppm dose, which increased to 63.33 days at 50 ppm dose. LS plants had early flowering time during all treatments. Higher dose of Cd i.e., 50 ppm, increased the flowering time i.e., caused late flowering (Table- 3, Graph- 3). In control TS plants the pod formation took place in 73.66 days. At 10 ppm and 20 ppm dose it was 71.33 days and 72.66 days respectively. But at 50 ppm dose the pod formation was delayed i.e., 77.33 days. The pod formation of control LS plants took place in 62.33 days. The pod formation at 10 ppm and 20 ppm dose was 63.33 days and 62.66 days respectively which increased to 72.33 days at 50 ppm dose. The pod formation was early in LS plants and was more or less the same for respective treatments but at 50 ppm dose of Cd the pod formation was delayed both in TS and LS plants (**Table- 4, Graph- 4**).

CONCLUSION

The results concluded that at 30 and 60 DAS LS plants showed more height and root length but 90 DAS TS had more height and root length. Early flowering and pod formation was found in LS plants.

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