

## RESPONSE OF CHILLI (*Capsicum annuum* L.) GENOTYPES WITH RESPECT TO DIFFERENT CONCENTRATIONS OF 2, 4-D

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**ABSTRACT** : The present investigation, carried out during spring-summer season of 2009-10 at Vegetable Research Centre of G.B. Pant University of Agriculture and Technology, Pantnagar, was aimed to optimize the dose of 2, 4-D used as a plant growth regulator in chilli to find out suitable genotypes assessing the variability of chilli crop occurred in India for cultivating in *tarai* region of Uttarakhand. The experiment was laid out in a Split Plot Design with three replications where the three levels of 2, 4-D i.e. 0, 2 and 4 ppm were applied in main plots and the 27 genotypes allotted to each main plot as subplot factor in each replication. The observations were recorded for growth and yield attributes viz. plant height, number of primary branches/ plant, fruit length, weight of fruits/plant, number of fruits/plant and fruit yield/ha. Among all the genotypes PC-7, PC-2064, PC-6, PC-4, and CCHO-5-8 performed better for growth and yield attributes and also produced significantly highest fruit yield (325.0, 270.0, 246.3, 246.3 and 240.9 q/ha, respectively) with application of 2, 4-D @ 4ppm . The results showed that 2,4-D @ 4 ppm had marked influence on growth and yield of chilli, followed by 2,4-D @2ppm produced highest fruit yield than check. Significant differences were also observed for genotypes and their interactions in respect of 2, 4-D for all the attributes.

**Keywords:** Chilli, 2, 4-D, growth, yield attributes.

Chilli, also known as hot pepper belongs to the family Solanaceae. Each part of the crop is of economic importance; green fruits are used to make pickles and in spicing of vegetables, dry fruits as in the form of powder and exhausted plants as timber in Indian Kitchens. Chillies are grown throughout the country covering an area of around 0.8 million ha (Deshpande, 4). However, the area and production under chilli cultivation varies state to states as well as region to region within a state. The genus *Capsicum* is considered as originated in tropics and subtropics of the New World. Nevertheless, chilli have adapted very well to the Indian conditions so much so that India is considered as secondary centre of origin. Two species of chilli namely *Capsicum annum* and *C. frutescens* are commercially cultivated throughout India (Saini and Singh, 11). That is why ample amount of variability in this crop exists all over India. In India, a majority of new cultivars and chilli hybrids have been developed in recent past with the objectives of higher fruit production. However, recommendations of these varieties/hybrids are unavailable to a particular region. The discovery of plant growth substances has proved revolutionary in increasing the production of horticultural crops (Choudhary *et al.*, 3). Now-a-days plant growth regulators are being too used to increase the production of vegetable crops like cucurbits, tomato, brinjal, chilli, okra etc (Singh and Verma, 13) Singh *et al.*, (16). From the studies carried out in past

by many researchers, it is quite evident that chilli and capsicum responded well in terms of growth as well as yield to an array of growth regulator. The spray dosage and degree of response of varieties/ cultivars/ genotypes were found varying with the chemicals tested.

Keeping the above points in mind, the present investigation was furnished to optimize the dose of 2, 4-D used as a growth regulator in chilli and to find out suitable genotypes by assessing the variability of this crop occurred in India for cultivating in *tarai* region of Uttarakhand.

### MATERIALS AND METHODS

The present investigation was carried out during spring-summer season of 2009-10 at Vegetable Research Centre of G.B. Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar, Uttarakhand, India. Geographically Pantnagar is situated between 29.50° North latitude and 79.20° East longitude and at an altitude of 243.83 metres above the mean sea level. Considering the eco-geographical conditions, Pantnagar is located at the foothills of Shivalik range in Himalayas and falls under the humid sub-tropical climate in a narrow belt called Tarai. Chilli crop performs well in warm humid tropical and subtropical regions under irrigated conditions. Chillies can be grown on wide range of soils but well drained sandy loam soil with slightly acidic pH and rich in organic matter are best suited for chilli cultivation

**Table 1: Effect of 2,4-D on plant height and number of branches in genotypes of chilli.**

Treatment 2, 4-D levels Genotypes	Plant height (cm)				Number of branches per plant			
	0 ppm 2, 4-D	2 ppm 2, 4-D	4 ppm 2, 4-D	Genotype means	0 ppm 2, 4-D	2 ppm 2, 4-D	4 ppm 2, 4-D	Genotype means
PS-12	67.15	68.00	71.50	68.88	7.00	6.50	7.00	6.83
PC-4	74.85	75.65	73.45	74.65	5.00	5.50	5.50	5.33
PC-5	74.85	66.90	64.40	68.72	6.00	6.25	6.75	6.33
PC-6	63.65	59.00	61.25	61.30	8.00	8.00	7.50	7.83
PC-7	76.90	81.25	82.55	80.23	10.00	10.00	10.00	10.00
PC-2057	50.55	50.80	56.00	52.45	5.00	6.00	7.25	6.08
PC2062	66.70	68.70	68.95	68.12	8.00	8.00	8.00	8.00
PC-2064	81.50	79.70	83.50	81.57	10.00	9.50	10.00	9.83
JCAA283	72.85	73.05	76.60	74.17	4.00	6.00	5.50	5.17
LCA-206	83.0	84.00	83.50	83.50	7.00	8.00	7.00	7.33
PS-3-4	76.40	78.05	79.10	77.85	8.00	7.50	7.50	7.67
AESO-6-1	66.10	63.90	67.60	65.87	6.00	7.00	7.00	6.67
AESO-6-2	102.00	99.95	102.00	101.32	6.00	6.00	6.00	6.00
VR-338	47.00	49.10	51.15	49.08	6.00	7.00	7.00	6.67
CCHO-5-8	57.65	59.65	58.85	58.72	7.00	7.00	6.00	6.67
BCC-1	50.50	53.70	53.85	52.68	4.00	5.00	4.00	4.33
PC-25	66.50	69.05	67.55	67.70	8.00	6.00	7.50	7.17
LCA-334	62.20	62.50	66.55	63.75	8.00	9.00	7.50	8.17
Entry-1	66.90	72.75	71.70	70.45	6.00	8.00	8.00	7.33
Entry-2	72.80	69.45	71.95	71.40	8.00	7.00	7.00	7.33
Entry-3	57.85	54.50	55.90	56.08	8.00	8.00	8.00	8.00
Entry-4	52.90	55.90	56.00	54.93	9.00	8.00	9.00	8.67
Entry-5	71.50	74.50	75.75	73.92	6.00	7.50	8.00	7.17
Entry-6	61.55	63.90	64.20	63.22	5.00	5.00	6.00	5.33
Entry-7	51.75	51.95	52.60	52.10	8.00	9.00	9.00	8.67
Entry-8	74.30	74.75	75.75	74.93	10.00	9.50	9.50	9.67
KA-2	54.45	55.75	54.75	54.98	6.00	6.00	6.00	6.00
<b>2, 4-D means</b>	66.83	67.27	68.41	67.50	7.00	7.27	7.32	GM=7.19
CV(%)=1.53		CD (P=0.05)				CD (P=0.05)		
2,4-D		0.043				0.063		
Genotypes		0.953				0.183		
Interaction (T x G)		1.652				0.321		

(Deshpande, 4). The soil of the experimental site was sandy loam in texture with pH 6.5 and organic carbon (0.51%). The treatments in present study comprised of twenty-seven genotypes of chilli, obtained/collected from PCPGR, Pantnagar from different sources and three levels of 2, 4-D dosages *i.e.*, 0 ppm, 2 ppm and 4 ppm. The experiment was laid out in a Split Plot Design with three replications where the levels of 2, 4-D dosages were applied in main plots and the genotypes were allotted to each main plot as subplot factors in each replication. The recommended standard dosages of fertilizers (nitrogen @ 120 kg/ha, phosphorus @ 60

kg and potash @ 50 kg K<sub>2</sub>O/ha) and standard package of practices were applied for raising a good crop. The crop plants were sprayed with 2, 4-D at 30 and 50 days after transplanting. The observations were recorded for plant height (cm), number of branches per plant, fruit length (cm), weight of fruits/plant (g), number of fruits/plant and fruit yield (q/ha) on five competitive randomly selected plants in each treatment and in each replication. The data collected for all characters were subjected to statistical analysis to test the significance of differences between the genotypes and doses of 2, 4-D and their interactions (Sahu and Dash, 10).

## RESULTS AND DISCUSSION

Data pertaining to plant height and number of branches per plant (Table 1) revealed that the application of 2,4-D in main plot and genotypes in subplot and their interaction effects were noticed significant for both the characters. The plant height slightly increased in most of the genotypes as the levels of 2,4-D advanced. Application of 2 4-D @ 4 ppm to chilli genotypes was found significantly superior to its other levels. So far about the performance of genotypes is concerned, maximum plant height of chilli was measured in the genotype AESO-6-2 (101.32 cm) followed by LCA-206 (83.50 cm), PC-2064 (81.57 cm) and PC-7 (80.23 cm). Plant height with more number of

branches is a desirable trait in chilli, as it increases the fruiting sites and thereby yields. Results are in agreement with Kumar *et al.* (7). The data revealed that the crop plants, in general, grew up to a height of 67.50 cm with 7.19 primary branches per plant. Number of branches per plant significantly varied among the genotypes and when plants sprayed with 2, 4-D at different levels it slightly increased over no application to 2 ppm to 4 ppm. Genotypes, PC-7, PC-2064 and Entry-8 registered the maximum number of branches per plant *i.e.* 10.00, 9.83 and 9.67, respectively. Balraj *et al.* (1) had reported that the plant height and number of branches in chilli improved when plant growth

**Table 2: effect of 2,4-D on fruit length and weight of fruits in genotypes of chilli.**

Treatment 2, 4-D levels Genotypes	Fruit length (cm)				Weight of fruits/plant (g)			
	0 ppm 2, 4-D	2 ppm 2, 4-D	4 ppm 2, 4-D	Genotype means	0 ppm 2, 4-D	2 ppm 2, 4-D	4 ppm 2, 4-D	Genotype means
PS-12	6.40	6.85	6.65	6.63	236.00	245.00	245.00	242.00
PC-4	7.10	7.55	7.20	7.28	620.00	617.50	610.00	615.83
PC-5	7.40	7.45	7.60	7.48	365.00	385.00	375.00	375.00
PC-6	8.15	8.45	8.90	8.50	612.50	617.50	617.50	615.83
PC-7	10.05	10.65	10.60	10.43	800.00	805.00	812.50	805.83
PC-2057	8.10	8.10	8.60	8.27	495.00	515.00	515.00	508.33
PC2062	7.80	7.90	8.30	8.00	490.00	540.00	540.00	523.33
PC-2064	8.10	8.40	8.95	8.48	660.00	657.50	675.00	664.17
JCAA283	7.05	7.60	7.95	7.53	247.50	245.00	255.00	249.17
LCA-206	6.65	6.60	6.60	6.62	259.00	270.00	265.00	264.67
PS-3-4	7.70	7.30	7.40	7.47	450.00	485.00	487.50	474.17
AESO-6-1	7.70	7.40	7.65	7.58	560.00	550.00	575.00	561.67
AESO-6-2	6.60	6.90	6.90	6.80	400.00	412.50	415.00	409.17
VR-338	6.40	6.60	6.40	6.47	335.00	335.00	365.00	345.00
CCHO-5-8	5.70	6.10	5.75	5.85	615.00	615.00	621.50	617.17
BCC-1	5.85	6.10	6.30	6.08	240.00	240.00	232.50	273.50
PC-25	8.15	8.15	8.20	8.17	525.00	535.00	550.00	536.67
LCA-334	7.30	7.70	7.35	7.45	302.25	307.50	307.50	305.75
Entry-1	7.45	7.70	7.40	7.52	225.00	242.50	240.00	235.83
Entry-2	7.90	8.00	8.15	8.02	185.00	205.00	219.00	203.00
Entry-3	8.20	8.45	8.55	8.40	170.00	150.00	160.00	160.00
Entry-4	7.30	7.65	7.70	7.55	207.50	220.00	215.00	214.17
Entry-5	5.75	6.30	6.40	6.15	367.50	380.00	392.50	380.00
Entry-6	7.85	6.85	7.90	7.53	285.00	267.50	282.50	278.33
Entry-7	5.30	5.30	5.40	5.33	347.50	360.00	375.00	360.83
Entry-8	6.00	6.40	6.05	6.15	195.00	220.00	205.00	206.67
KA-2	4.35	4.40	4.55	4.43	162.50	165.00	165.00	164.17
<b>2, 4-D means</b>	7.14	7.29	7.37	7.27	383.60	392.41	396.69	390.90
	CD (P=0.05)				CD (P=0.05)			
2,4-D	0.027				0.212			
Genotype	0.011				9.118			
Interaction (T x G)	0.187				15.792			

regulators applied. Similar results were also reported by Sheela *et al.* (12) and Singh *et al.* (16).

The direct effects of 2,4-D, genotypes and the interaction effects of both were found significant for fruit length as well as weight of fruits per plant (Table 2). On an average, fruits of the chilli were 7.27 cm long. Maximum fruit length (7.37 cm) was registered with application of 2,4-D @ 4ppm. Significant differences were recorded among the genotypes where maximum fruit length was noted in PC-7 (10.43 cm), followed by PC-6 (8.50 cm) and PC-2064 (8.48 cm). Due to interaction effects of 2,4-D levels and genotypes, fruit length increased in most of the genotypes with increment in doses of 2,4-D. The results revealed that

different levels of 2,4-D exhibited marked influence on weight of fruits per plant. Significant increase in the weight of fruits per plant was observed with spraying of 2,4-D on plants over control i.e. no application (0ppm). In general, crop produced 390.9g fruits per plant. Whereas it linearly increased with increment in doses of 2,4-D from 0, 2 and 4 ppm by producing as 383.6g and 392.41 g to 396.69 g fruits per plant, respectively. Unlike 2,4-D effects, mean values for weight of fruits per plant significantly scattered among genotypes without following any trend may be due to existing genetic variability in germplasm. Genotypes *viz.* PC-7, PC-2064 and CCHO-5-8 significantly produced maximum weight of fruits per plant *i.e.* 805.83,

**Table 3: Effect of 2,4-D on number of fruits and fruit yield in genotypes of chilli.**

Treatment 2, 4-D levels Genotypes	Number of fruits/plant				Fruit yield (q/ha)				
	0 ppm 2, 4-D	2 ppm 2, 4-D	4 ppm 2, 4-D	Genotype means	0 ppm 2, 4-D	2 ppm 2, 4-D	4 ppm 2, 4-D	Genotype means	
PS-12	158.00	165.00	162.00	161.67	94.40	98.00	98.00	96.80	
PC-4	315.00	315.00	310.00	313.33	248.00	247.00	244.00	246.33	
PC-5	245.00	265.00	260.00	256.67	146.00	154.00	150.00	150.00	
PC-6	404.00	407.50	418.50	410.00	245.00	247.00	247.00	246.33	
PC-7	417.50	421.00	421.50	420.00	320.00	322.00	325.00	322.33	
PC-2057	317.50	322.50	317.50	319.17	198.00	206.00	206.00	203.33	
PC2062	360.00	345.00	337.50	347.50	196.00	216.00	216.00	209.33	
PC-2064	400.00	400.00	406.50	402.17	264.00	263.00	270.00	265.67	
JCAA283	247.50	262.50	267.50	259.17	99.00	98.00	102.00	99.67	
LCA-206	207.50	217.50	215.00	213.33	103.60	108.00	106.00	105.87	
PS-3-4	295.00	305.00	315.00	305.00	180.00	194.00	195.00	189.67	
AESO-6-1	175.00	200.00	210.00	195.00	224.00	220.00	230.00	224.67	
AESO-6-2	166.00	171.00	179.00	172.00	160.00	165.00	166.00	163.67	
VR-338	215.00	217.50	223.00	218.50	134.00	134.00	146.00	138.00	
CCHO-5-8	147.50	161.50	153.50	154.17	246.00	246.00	248.60	246.87	
BCC-1	177.50	177.50	190.00	181.67	96.00	96.00	93.00	95.00	
PC-25	247.50	259.00	271.50	259.33	210.00	214.00	220.00	214.67	
LCA-334	197.50	197.50	207.50	200.83	120.90	123.00	123.00	122.30	
Entry-1	155.00	163.00	164.00	160.67	90.00	97.00	96.00	94.33	
Entry-2	149.00	163.50	159.00	157.17	74.00	82.00	87.60	81.20	
Entry-3	134.00	144.00	142.50	140.17	68.00	60.00	64.00	64.00	
Entry-4	131.50	133.50	139.00	134.67	83.00	88.00	86.00	85.67	
Entry-5	204.00	209.00	226.00	213.00	147.00	152.00	157.00	152.00	
Entry-6	175.00	162.50	175.00	170.83	114.00	107.00	113.00	111.33	
Entry-7	137.50	139.00	142.50	139.67	139.00	144.00	150.00	144.33	
Entry-8	195.00	210.00	207.50	204.17	78.00	88.00	82.00	82.67	
KA-2	137.50	145.00	145.00	142.50	65.00	66.00	66.00	65.67	
<b>2, 4-D means</b>	226.35	232.57	235.78	231.57	153.44	156.96	158.67	GM=156.36	
CD (P=0.05)					CD (P=0.05)				
2,4-D					0.0385	0.181			
Genotype					3.649	3.647			
Interaction (T x G)					6.324	6.316			

664.17 g and 617.17 g, respectively. Another side, Entry-3 and KA-2 gained the poorest performance for this character *i.e.* 160 g and 164.17 g, respectively. Interaction effects showed that the genotype, PC-7 recorded maximum weight of fruits per plant (812.50 g) followed by PC-2064 (675.00 g) when plants sprayed with 2,4-D @ 4 ppm. The results are in agreement to the findings of Barai and Sarkar (2), Gogoi and Gautam (5), Joshi and Singh (6), Singh and Shankar (17) and Singh *et al.* (14).

The results (Table 3) revealed that different levels of 2, 4-D had marked influence on total number of fruits per plant. Significant variation in the total number of fruits per plant was observed with the application of 2,4-D at different levels. The data clearly indicated sprays of increased levels of 2,4-D dosages on plants increased number of fruits per plant (226.35 fruits/plant by 0 ppm, 232.57 fruit/plant by 2 ppm and 235.78 fruits by 4 ppm). Among genotypes, PC-7 produced highest number of fruits per plant (420.00) followed by PC-6 (410.00) and PC-2064 (402.17). Among interactions, these three genotypes again, recorded highest number of fruits (421.50 418.50 and 406.50, respectively) with application of 2,4-D @ 4 ppm as compared to others. On an average the crop produced 231.57 fruits per plant. Generally crop produced unreliable fruit yield (156.36 q/ha) which significantly increased with increment in doses of 2,4-D over non application. A definite trend was noticed for this trait with respect to 2,4-D application. In this investigation, it was noted that every increment in dosages of 2,4-D from 0 ppm to 2 ppm to 4 ppm brought remarkable yield benefit (153.44 q/ha to 156.96 q/ha to 158.67 q/ha, respectively). Maximum fruit yield was obtained from the genotype PC-7 (322.33 q/ha) followed by PC-2064 (265.67 q/ha) among all the genotypes. Consequently, interaction effects showed that the genotypes PC-7 and PC-2064 with application of 2,4-D @ 4 ppm produced significantly high fruit yield (325 q/ha and 270 q/ha, respectively) over performance of other genotypes and the chilli crop in general. This might have been due to either more number of fruits or heavy weight of fruits per plant in both the genotypes. Numbers of fruits per plant and fruit yield affected by application of different plant growth regulators (Lone *et al.*, 8). The results obtained by Singh *et al.* (15) and Munsri and Sadhukhan (9) support the findings of the present study. However, further addition of the 2,4-D dosages may lead to poor performance of crop or can be exploited to increase fruit yield once again.

## Conclusion

On the basis of the present results, application of 2,4-D @ 4 ppm on the crop may be recommended for better response of chilli towards increased yield. On the other hand, genotypes PC-7 and PC-2064 performed best for the growth and yield attributing characters which gave rise to high yields with respect to 2,4-D application. Thus, these chilli genotypes may be use for the cultivation in *tarai* regions of Uttarakhand.

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