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The study on treatment of nitrogen and spacing with variety snowball

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Abstract
Field experiment regarding the effect of three levels of nitrogen control, lowest and highest dose per hectare which was supplied by means of urea and three levels of spacing that is 30cm, 45cm and 60cm each were carried out and cauliflower seedlings were transplanted in the field on 28 December 2013 at the Vegetable Farm of Udai Pratap Autonomous College, Varanasi. Nitrogen application had significant effect for all the characters at all the stages of the cauliflower plant. Highest dose of nitrogen per hectare had significant effect on the height of the plant, fresh and dry weight of leaves and fresh and dry weight of curd at different stages of period. Spacing had also a significant effect on height of the plants, fresh and dry weights of curd at 60cm. spacing distance each significantly effective in above trials.

Keywords: Nitrogen and spacing, variety snowball, minerals

Introduction
Vegetable are vital sources of minerals, vitamins and carbohydrate dietary which play an important role in human nutrition. Apart from nutrition, they also contain a wide array of potential photochemical like anti carcinogenic and antioxidant. India ranks second in the production of vegetables after China. The cauliflower belongs to the family cruciferae and chromosome no. 18 botanically known as *Brassica oleracea L. var. Botrytis* is one of the important vegetable crops of India and it grown for white tender head or curd formed by the shortened flower parts. The name cauliflower goes by the Latin name caulis which means cabbage and floris which means flower said to be the native of South Europe in the Mediterranean region (Thompson and Kelly, 1957.) [9] The cauliflower is an important winter season vegetable crop in India. It originated in the island of Cyprus from where it moved to other areas like Syria, Turkey, Egypt, Italy, Spain and North Western Europe. (Boswell 1949). It was introduced to India in 1822 by a botanist James from Kew Garden, London. It is used as a vegetable in curries and soups, and making for pickles. It may be cooked alone or mixed potatoes. It contains a good amount of vitamins B and a fair amount of proteins. The nutritive value of cauliflower is given according to (Premnath, 1976): Per 100 g of edible cauliflower contain (Moisture 90.80, Mineral 1.9, Carbohydrate 4g, Potassium 113mg, Fat 0.4g, Phosphorus 57mg, Proteins 2.6g, Calcium33mg, Calories 30, Iron1.5, Vitamin A 51.1U, Vitamin C 56mg.). There is an urgent and stressing need to augment production of vegetables in India if we want to have a healthy nation. Looking at the importance of this crop and future prospects of this cultivar, present investigation namely. The spacing in cauliflower cultivation is to obtain better curd yield without adversely affecting the quality was carried out during the year 2012-2013 in agro – climatic condition of Varanasi district is hopes that results of these investigations might prove some importance towards successful cultivation of cauliflower.

Materials and Methods
Materials and methods adopted in this experiment are described below- Randomized Block Design of Layout was followed taking into consideration each treatment as an independent character. Three levels of nitrogen and three levels of spacing with snowball were adopted. The nitrogen and spacing were major importance.

Thus the altogether 27 plots were prepared to accommodate 3 replications of different treatments with necessary path irrigation channel. In the experiment of present investigation, the treatment of nitrogen is levels of Nitrogen, 0 kg, 150 kg, 200 kg nitrogen per hectare and spacing with variety snowball were as distance between rows 30 cm, 45 cm, 60 cm.

The observations were recorded to study the different characters of plants grown in different treatments in each replication. The following characters were studied:

Height of plant (cm)
The height of plants from bottom of levels of ground to the tips of leaves was measured at on interval of 20 days with the help of meter scale.

Fresh weight of the plant (g)
Three plants from each plot were selected and average weight of the plants was recorded, the intervals between observations were same as above.

Number of leaves
The leaves of selected sample account the total leaves and recorded the number.

Fresh weight of head (g)
The selected three heads removed and weighed on balance and recorded the weight in

Dry weight of leaves (g)
After taking the fresh weight of leaves dried in the electronic oven and weighed out on physical balance in g.

Dry weight of head (g)
After taking the fresh weight of head dried in the electronic over and weighed out on physical balance in g.

Yield
The total yield per sub-plot was recorded by weighing the whole harvested curd of each sub-plots. On this basis the yield per hectare were calculated in quintal.

Statistical Analysis of Data
The observations recorded on various characters were subjected to statistical analysis to find out the significance of the treatment on the characters under study. The experiment was conducted in randomized block design. The sum of squares and the mean sum of squares for the various treatment effects as well as replication were calculated in usual way.

Results and Discussion
Very interesting results were obtained when the effect of levels of nitrogen on various growth characters was studies. Untreated plant character with regard to growth was taken as control and the comparison of the variation in the growth characters of the treated plant was made to find out the significance effects.

Height of plant
Height of the plant, were significantly affected by 150 and 200 kg nitrogen per hectare at all the stages of life cycle. At 20 days stage 200 kg per hectare nitrogen was effective a very high degree to cause an increase of height of the plant 40.50cm, under 150kg nitrogen per hectare the plant height 35.72cm, when nitrogen was not applied the plant height 30.41cm were observed. At 40 day stage, the plant height was 55.11cm observed under 200kg nitrogen level, under 150kg nitrogen per hectare the plant height 47.71cm, the plant height 42.94 cm were observed under control condition. At 60 day stage the plant height was 60.31cm observed under 200kg nitrogen level, under 150kg nitrogen per hectare the plant height 56.85cm, when nitrogen was not applied the plant height 43.80cm were observed. At 80 days stage also gave very good performance for the height of plant 61.18cm were observed under 200kg, also gave very good results for the height of plant 58.81cm at 150kg, when nitrogen was not applied the plant height 46.82cm, were observed. The effect of different levels of nitrogen at 20, 40, 60 and 80 days stages on height of plant were found highly significant at 1% level of signification (table-1). This height increased mainly due to rapid cell division and cell elongation in the meristematic regions. Plant growth with higher levels of protein and carbohydrate. These two compounds when present in highamounts in meristematicregions, induce rapid cell division and greater enlargement of the cells which ultimately result in increased height of the plant. In cauliflower, Srivastava (1958) [8] and Choudhary (1961) [2] have found increase in height with increasing nitrogen supply.

Fresh weight of the plant (g)
At 20 days stage 200kg per hectare nitrogen was effective a very high degree to cause an increase of fresh weight of plant 17.56g, 150kg, per hectare nitrogen was effective a very high degree to cause an increase of fresh weight of plant 15.14kg when nitrogen was not applied fresh weight of the plant 13.71g were observed. At 40 days stage 200 kg per hectare nitrogen was effective a very high degree to cause an increase was effective a very high degree to cause an increase of fresh weight of plant 139.39g when nitrogen was not applied fresh weight of the plant 73.43 g were obtained. At 60 days stage 200 kg per hectare nitrogen was effective a very high degree to cause an increase of fresh weight of plant 363.65g, 150kg per hectare nitrogen was effective a very high degree to cause an increase of fresh weight of plant 352.30g. When nitrogen was not applied fresh weight of the plant 267.06 g were obtained. At 80 days stage 200kg per hectare nitrogen was effective a very high degree to cause an increase of fresh weight of plant 450.26g this is a very good performance. 150 kg per hectare nitrogen was effective a very high degree to cause an increase of fresh weight of plant 364.18g when nitrogen was not applied fresh weight of the plant 289.68g were obtained. The fresh weight of plants was found highly significant (table-2). Nitrogen is central determinant of leaf photosynthetic capacity and yield. Its availability increases leaf water potential wall expansion properties of growing tissue which ultimately result in increased fresh weight of plant. This was also reported in cauliflower by (Lal and Subbarao, 1960; Crane and Steward, 1962) Ram and Sharma (1969).

Number of leaves
At 20 days stage200 kg per hectare nitrogen was effective a very high degree to cause an increase of number of leaves 20.88, 150 kg per hectare nitrogen was effective a very high degree to cause an increase of number of leaves 16.96, when nitrogen was not applied number of the leaves 13.08, when nitrogen was not applied number of the leaves 22.36, were obtained. At 60 days stage 200 kg per hectare nitrogen was effective a very high degree to cause an increase of number of leaves 33.11, at 60 days stage, 150kg per hectare nitrogen was effective a very high degree to cause an increase of number of leaves 30.00, when nitrogen was no applied number of the leaves 26.72, were obtained At 80 days stage 200 kg per hectare nitrogen was effective a very high degree to cause an increase number of leaves 38.19g this is very good performance. When nitrogen was not applied number of the leaves 33.31, were obtained.

The fresh weight of plants were found highly significant. (Table-3) This was also reported by Ram and Sharma (1969). Deficiency of nitrogen resulted reduced fresh weigh of constituent organs and whole plant (Lal and Subbarao, 1960; Crane and Steward, 1962). When the leaf number are less and size is small due to deficiency of nitrogen, results in less growth of cauliflower, this less growth obviously due to less meristematic activity.

Fresh weight of head

At 60 days stage 200 kg per hectare nitrogen was effective a very high degree to cause an increase of fresh weight of head 338.22g, 150kg high degree to cause an increase of fresh weight of head 338.22g, 150kg per hectare nitrogen was effective a very high degree to cause an increase of fresh weight of head 237.08g, the values were recorded for the fresh weight of head are 168.68g under control condition. At 80 days stage 200kg per hectare nitrogen was effective a very high degree to cause an increase of fresh weight of head 576.33g, 150kg per hectare nitrogen was effective a very high degree to cause an increase of fresh weight of head 368.89g, the result of the fresh weight of curd 255.14g were obtained in the absence of nitrogen. The fresh weight of head was found highly significant (table-4). Higher dose of nutrients enhanced synthesis and accumulation of food thereby resulted in higher head weight. The increased application of nutrient levels increases the growth parameters which might have synthesized more plant metabolites. These results are corroborated with those obtained by Kumar and Sahu (2013) [5], similar result was also reported White and Forbes (1976) [10, 11].

Dry weight of leaves

At 20 days stage 200 kg per hectare nitrogen was effective a very high degree to cause an increase of dry weight of leaves 2.03 g at 20 days stage, 150 kg per hectare nitrogen was effective a very high degree to cause an increase of dry weight of leaves 1.73g when nitrogen was not applied dry weight of the leaves. 1.40g were obtained. At 40 days stage, 200kg per hectare nitrogen was effective a very high degree to cause an increase of dry weight of leaves 13.69g, 150kg per hectare nitrogen was effective a very high degree to cause an increase of dry weight of leaves 11.37g, when nitrogen was not applied dry weight of the leaves 6.12g were obtained. Similarly the constituent organs are greatly influenced by the nitrogen application.

Table 1: Height of plant of cauliflower as affected by various level of nitrogen (N_0 =kg N/ha, N_1=150kg, N_2-200kgN/ha)

Ageing days	Nitrogen (kg.)	Distance between rows (cm)			Mean	C.D. at 5%
		S_1	S_2	S_3		
20	N_0	28.62	30.03	32.59	30.41	N&S=0.037
	N_1	34.03	35.82	37.30	35.72	NXS=0.029
	N_2	38.05	40.15	43.30	40.50	
	Mean	33.57	35.33	37.73		
40	N_0	41.34	42.53	44.94	42.94	N&S=0.018
	N_1	46.64	47.66	48.83	47.71	NXS=0.031
	N_2	52.67	55.24	57.43	55.11	
	Mean	46.88	48.48	50.40		
60	N_0	40.64	42.91	47.85	43.80	N&S=0.0365
	N_1	55.02	56.71	58.83	56.85	NXS=0.632
	N_2	58.08	61.03	61.86	60.31	
	Mean	51.23	53.55	56.18		
80	N_0	44.73	45.96	49.77	46.82	N&S=0.0365
	N_1	57.97	58.66	59.80	58.81	NXS=0.0632
	N_2	59.02	61.66	62.87	61.18	
	Mean	53.91	55.43	57.48		

Table 2: Fresh weight of plant of cauliflower as affected by level of nitrogen (N_0 =kg N/ha, N_1=150kg, N_2-200kgN/ha.)

Age in days	Nitrogen (kg.)	Distance between rows (cm)			Mean	C.D. at 5%
		S_1	S_2	S_3		
20	N_0	12.54	14.74	13.86	13.71	N&S=0.122
	N_1	12.53	16.83	16.35	15.14	
	N_2	15.53	18.73	18.62	17.56	NXS=0.212
	Mean	13.37	16.77	16.28		
40	N_0	64.94	68.74	86.62	73.43	N&S=0.079
	N_1	132.72	137.83	147.63	139.39	NXS=0.137
	N_2	135.83	152.81	184.83	157.82	
	Mean	111.16	119.79	139.69		
60	N_0	265.02	267.23	268.94	267.06	N&S=0.049
	N_1	302.53	362.35	392.02	352.30	NXS=0.087
	N_2	322.94	331.24	393.77	363.65	
	Mean	296.83	320.27	344.91		
80	N_0	264.86	296.03	308.16	289.68	N&S=0.035
	N_1	331.94	361.83	398.76	364.18	NXS=0.61
	N_2	409.14	468.40	473.23	450.26	
	Mean	335.31	375.42	393.38		

Table 3: Number of leaves of cauliflower plant as affected by levels of nitrogen (N_0 =kgN/ha, N_1=150kg, N_2-200kgN/ha.)

Age in days	Nitrogen (kg.)	Distance between rows (cm)			Mean	C.D. at 5%
		S_1	S_2	S_3		
	N_0	11.82	12.29	14.42	13.08	N&S=0.035
	N_1	15.84	17.14	17.89	16.96	NXS=0.061
20	N_2	19.32	21.12	22.19	20.88	
	Mean	15.66	17.08	18.17		
	N_0	21.04	22.42	23.61	22.36	N&S=0.083
	N_1	25.62	26.65	27.71	26.26	NXS=0.144
40	N_2	29.03	31.31	32.40	30.91	
	Mean	25.23	26.79	27.91		
	N_0	25.24	26.37	28.54	26.72	N&S=0.029
	N_1	28.83	30.03	31.14	30.00	NXS=0.051
60	N_2	31.71	32.97	34.64	33.11	
	Mean	28.59	29.69	31.44		
	N_0	31.77	33.36	34.81	33.31	N&S=0.039
	N_1	36.96	37.93	39.70	38.19	NXS=0.67
80	N_2	42.52	44.70	47.13	44.78	
	Mean	37.08	38.66	40.55		

Table 4: Fresh weight of head cauliflower as affected by levels of nitrogen (N_0 =kgN/ha, N_1=150kg, N_2-200kgN/ha.)

Age in days	Nitrogen (kg.)	Distance between rows (cm)			Mean	C.D. at 5%
		S_1	S_2	S_3		
	N_0	135.07	153.56	217.41	168.68	N&S=0.042
60	N_1	25.92	240.11	245.20	237.08	NXS=0.073
	N_2	315.11	315.13	384.41	338.22	
	Mean	225.37	236.27	283.34		
	N_0	218.37	236.27	282.34	225.14	N&S=0.035
80	N_1	318.39	334.52	453.76	368.89	NXS=0.061
	N_2	508.22	573.89	646.89	576.33	
	Mean	348.39	382.27	469.71		

Table 5: Dry weight of leaves cauliflower as affected by levels of nitrogen (N_0 =kg N/ha, N_1=150kg, N_2-200kg N/ha)

Age in days	Nitrogen (kg.)	Distance between rows (cm)			Mean	C.D. at 5%
		S_1	S_2	S_3		
60	N_0	135.07	153.56	217.41	168.68	N&S=0.042
	N_1	25.92	240.11	245.20	237.08	NXS=0.073
	N_2	315.11	315.13	384.41	338.22	
	Mean	225.37	236.27	283.34		
80	N_0	218.37	236.27	282.34	225.14	N&S=0.035
	N_1	318.39	334.52	453.76	368.89	NXS=0.061
	N_2	508.22	573.89	646.89	576.33	
	Mean	348.39	382.27	469.71		

Table 6: The age of nitrogen distance between

Age in days	Nitrogen (kg.)	Distance between rows (cm)			Mean	C.D. at 5%
		S_1	S_2	S_3		
60	N_0	17.20	21.57	35.64	21.47	N&S=0.035
	N_1	26.76	30.26	36.1	31.04	NXS=0.061
	N_2	40.53	45.91	49.71	45.38	
	Mean	28.16	32.58	37.15		
80	N_0	22.41	27.07	34.71	27.06	N&S=0.034
	N_1	38.30	44.37	50.21	44.30	NXS=0.059
	N_2	57.71	65.08	76.93	66.57	
	Mean	39.47	45.71	52.96		

Table 7: Yield of plant of cauliflower as affected by level of nitrogen (N_0 =kg N/ha, N_1=150kg, N_2-200kg N/ha)

S. No.	Treatments	No. of plant Per hact.	Weight (kg/ha)	Yield per ha. (Quintal)
1.	N_0 S_1	87500	177.97	177.97
2.	N_0 S_2	62500	139.53	139.53
3.	N_0 S_3	50000	127.30	127.30
4.	N_1S_1	87500	343.26	343.26
5.	N_1 S_2	62500	278.75	278.75
6.	N_1 S_3	50000	252.92	252.92
7.	N_2 S_1	87500	453.50	453.50
8.	N_2 S_2	62500	388.30	388.30
9.	N_2 S_3	50000	372.50	372.50

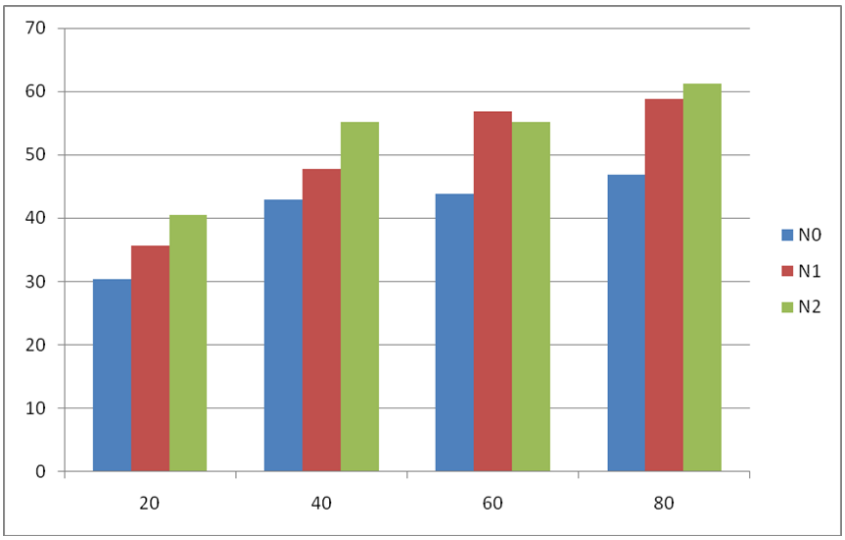

Fig 1: Effect of various levels of N on the height of cauliflower plant

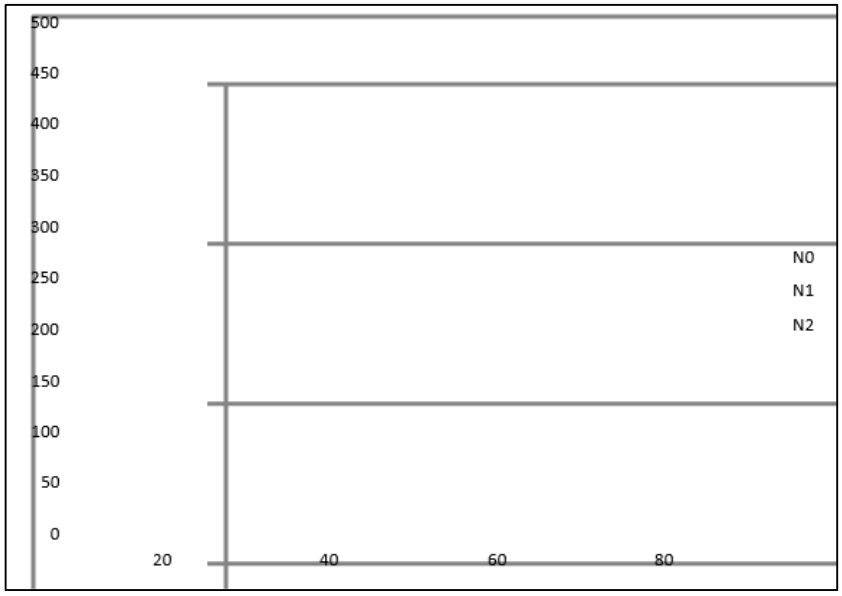

Fig 2: Effect of various levels of N on the fresh weight of cauliflower plant.

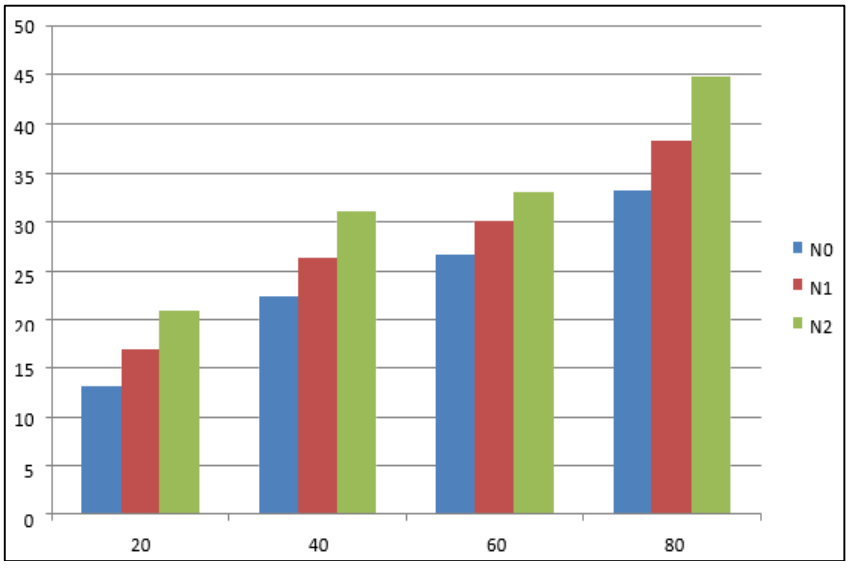

Fig 3: Effect of various levels of N and on the number of leaves per cauliflower plant

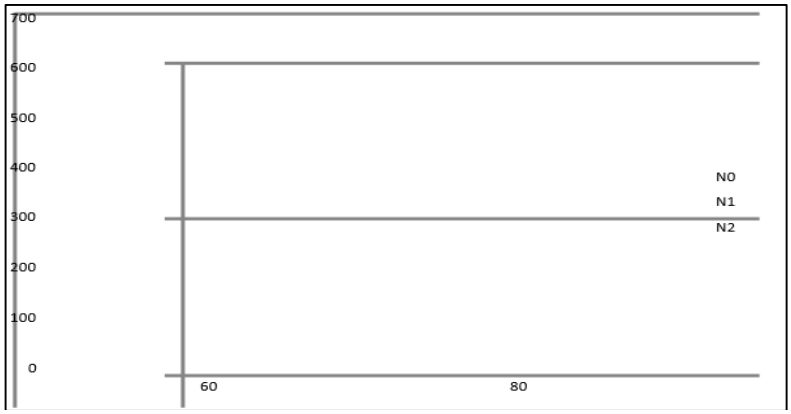

Fig 4: Effect of various levels of N and on the fresh weight of head of caulifloer plant.

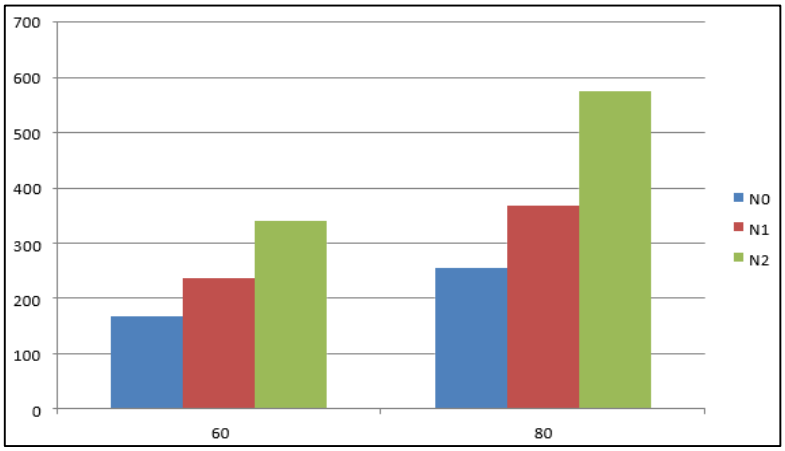

Fig 5: Effect of various levels of N on Dry weight of leaves of cauliflower plant

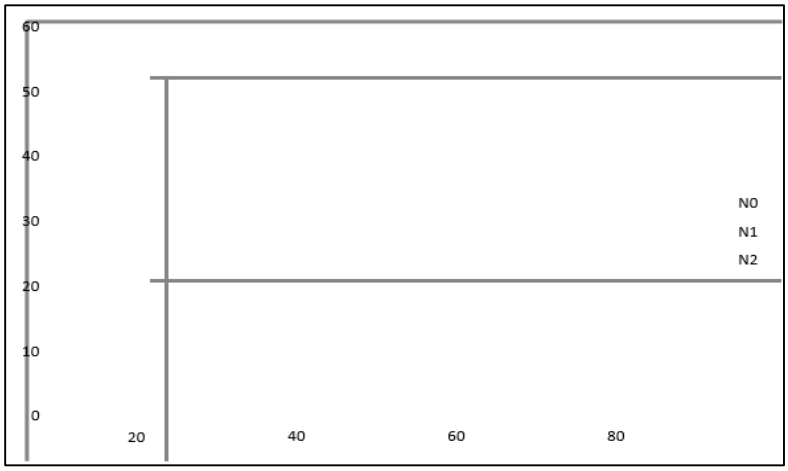

Fig 6: Effect of various levels of N on dry weight of head of cauliflower plant

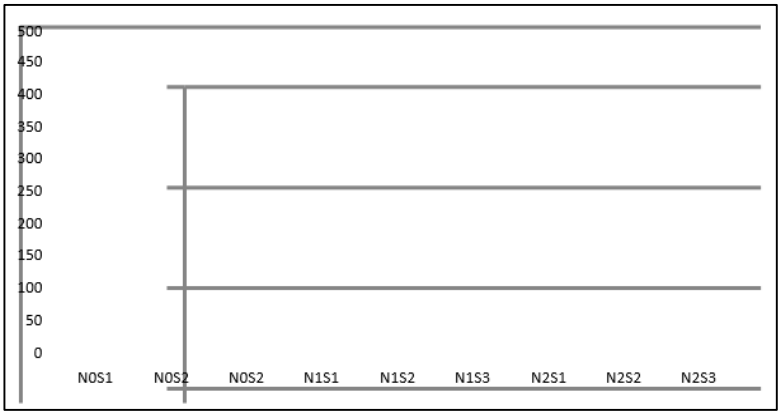

Fig 7: Effect of various levels of N on yield (q/ha) of cauliflower plant

The highest dose of nitrogen i.e., 200kg per hectare increased the dry weight of constituent organs over 150 kg per hectare and 0kg per hectare (Table-5). We know the fact very well that nitrogen increases (Fig. 5) growth and thereby increase in dry matter accumulation. Explanation for above statement may be given that nitrogen increases the formation of new leaves and leaves help for synthesis of carbohydrates and other nitrogenous compounds which are a must of ultimately this gives more dry matter, These finding is supported by Mishra *et al.,* (2014) [6].

Dry weight of head

At 60 days stage, 200 kg per hectare nitrogen was effective a very high degree to cause an increase of dry weight of head 45.38g, 150kg per hectare nitrogen was effective a very high degree to cause an increase of dry weight of head 31.04g, when nitrogen was not applied dry weight of head 21.47kg were obtained. At 80 days stage, 200 kg per hectare nitrogenwas effective a very high degree to cause an increaseofdryweightofhead66.57g,150kg per hectare nitrogen was effective a very high degree to cause an increase of dry weight of head 44.30g, when nitrogen was not applied dry weight of head 27.06g were obtained. The dry weight of leaves was found highly significant. (Table-6). These results are in agreement with the findings of Haque (2015) [4] in cabbage, EI- Bassiony *et al.,* (2014) [3] in kohlrabi and Zaki *et al.,* (2015) [12] in broccoli.

Yield

The calculated values for yield in quintals per hectare were obtained for each treatment which is shown in (Table-7). The maximum yield per hectare 453.50 quintals were found under N_2S_1 treatment 200kg nitrogen levels at 30 cm distance. Caruso (1969) [1] reported that the nitrogen was very effective specially when applied with phosphorus at the ratio of 120-140kg per hectare. The effect of phosphorus was uncertain but application of nitrogen increased the yield and headsize.

Nitrogen application had significant effect for all the characters at all the stages of the cauliflower plant. Highest dose of nitrogen per hectare had significant effect on the height of the plant, fresh and dry weight of leaves and fresh and dry weight of curd at different stages of period. Spacing had also a significant effect on height of the plants, fresh and dry weights of curd at 60cm. rows distance each significantly effective in above trials. The highest yield per hectare was obtained 453.50 quintals per hectares on treatment 200kg nitrogen level, and at 30cm distance. It clearly showed that there was spacing between rows but the yield per hectare was appreciably reduced as compared to closer spacing. Thus a spacing of 30cm between rows gave the highest yield per hectare. Growth characters showed favourably the increasing tendency with increasing distance between rows.

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