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# Effects of Planting Date and Growth Hormone on Growth and Yield of Cauliflower

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**Abstract**

An experiment was conducted at the Horticulture Farm of Bangladesh Agricultural University, Mymensingh, during the period from October 2014 to March 2015 to study the effects of planting date and growth hormone on the growth and yield of cauliflower. The experiment consisted of two factors; Factor A: Three planting dates, such as $P_1$: Planting on 1 November; $P_2$: Planting on 15 November and $P_3$: Planting on 1 December; Factor B: Four levels of Growth hormone, such as $H_0$: No Hormone (control); $H_1$: 10 ppm IAA (Indole-3 Acetic Acid); $H_2$: 70 ppm $GA_3$ (Gibberellic Acid) and $H_3$: 10 ppm IAA + 70 ppm $GA_3$. The experiment was laid out following Randomized Complete Block Design (RCBD) with three replications. In case of planting date, the highest plant height (63.26 cm), number of leaves per plant (24.13), leaf length (59.26 cm), leaf breadth (19.31 cm) at harvest, curd diameter (22.25 cm), marketable yield per hectare (28.11 t $ha^{-1}$) were recorded from $P_2$ and the lowest of those parameters were recorded from $P_3$. In case of growth hormone the highest plant height (63.10 cm), number of leaves per plant (23.66), leaf length (59.05 cm), leaf breadth (18.98 cm) at harvest, curd diameter (22.39 cm), marketable yield per hectare (29.88 t $ha^{-1}$) were recorded from $H_3$ and the lowest of those perameters were recorded from $H_0$. Combination of planting date and growth hormone the highest plant height (65.96 cm), number of leaves per plant (26.42), leaf length (63.64 cm), leaf breadth (20.92 cm) at harvest, curd diameter (25.75 cm), marketable yield per hectare (31.03 t $ha^{-1}$) were recorded from planting on 15 November and 10 ppm IAA with 70 ppm $GA_3$ ($P_2H_3$) and the lowest parameters (21.75 t $ha^{-1}$) were recorded from planting on 1 December and no hormone ($P_3H_0$). It is apparent from the above results that the combination of planting on 15 November and 10 ppm IAA with 70 ppm $GA_3$ ($P_2H_3$) was more productive from the other combinations.

**Key Words:** Cauliflower, Growth hormone, Planting date and Yield

## Introduction

Cauliflower (*Brassica oleracea* var. *botrytis* sub var. *cauliflora*) is one of the most important cole crops belonging to the family Brassicaceae. The leading cauliflower production countries of the world are China, Pakistan and India in respect of yield per hectare of land. Cauliflower is a very tasty and much popular vegetable in Bangladesh as well as all over the world. 100 g edible part of cauliflower contains 89% moisture, 8.0 g carbohydrates, 2.3 g proteins, 40 IU carotene, 0.13 mg $B_1$, 0.11 mg $B_2$, 50 mg vitamin C, 30 mg calcium and 0.8 mg iron and also contains 30 calories (Rashid, 1999). Edible part of cauliflower is commonly known as 'Curd'.

Vegetable consumption in Bangladesh is very low, only 32 g per person per day against the minimum recommended quantity of 200g per day (FAO, 2007). The total vegetable production in Bangladesh is far below the requirement. In 2012- 2013 cauliflower covered an area of 30,900 hectares with a total production of 101,485 metric tones (BBS, 2012). The suitable temperature for growth stages ranging from $20^0 \pm 5^0$C. The best temperature for curd growth and development is 15°C to 20°C. Planting date is one of the important factors for successful production of cauliflower. As a seasonal crop, cauliflower needs to plant in optimum time to return the maximum yield and benefit. Early planting produced the largest curd and maximum yield compared to the late planting. Malformation of curd also been reported in case of too early planting and late planting reduces curd size (Katharine, 1963). Many experiments have been carried out in developed country to investigate the effect of bio-chemical substances on the yield and quality of cauliflower. Reports so far been made indicated a promising results on yield and quality of cauliflower and other crops due to the use of bio-chemical substances, such as Napthaline acetic acid (NAA), Gibberellic acid ($GA_3$), Indole acetic acid (IAA) etc. (Voronova and Kozakov, 1983; Senthelhas *et al*., 1987; Tadzhiryan, 1990; Tomar *et al*., 1991). In addition, it is generally accepted that a biochemical processes are affected by a single chemical or a mixture of chemicals is not only different for between species but also for cultivars within the species and due to climatic regions (Hardy, 1979). However, recently done preliminary trials indicate possibility of yields increase of Cauliflower in Bangladesh with the use of biochemical (Islam *el al*., 1993; Biswas and Mondal, 1994). Plant height, curd formation and curd size of Cauliflower can be increased with foliar application of plant growth hormone. Several experiments were conducted to increase the yield of cauliflower. $GA_3$ and IAA have a positive role on curd formation and curd size of cauliflower (Sharma and Mishra, 1989).

At present growth hormones are widely used in horticultural crop production all over the world. Growth hormones play a vital role in growth and development of cauliflower. Some plant growth hormones like Auxin, Gibberellins, Cytokinin etc. are involved with the physiological activities in plants. IAA is one of the plant growth regulators (PGRs) play an important role in cell division, promoting cell elongation, callus formation which enhance plants vegetative growth. Gibberellins are also important PGR, control plant growth and development with the most interesting with respect to the photoperiodic control of flowering. The cauliflower plant showed that $GA_3$ at 100 ppm

produced the tallest plants, the largest curds and highest curd yields (Vijay and Ray, 2000).

Considering the background stated above, the present study was undertaken to investigate the effect of planting date and growth hormone with the following objectives-

i. to find out the appropriate planting date of cauliflower in relation to yield contributing characters and yield;

ii. to find out the appropriate amount of growth hormone of cauliflower in relation to yield contributing characters and yield; and

iii. to know the combined effect of planting date and growth hormone for ensuring the maximum growth and higher yield of cauliflower.

## Materials and Methods

The present investigation was carried out at the Horticulture Farm, Bangladesh Agricultural University, Mymensingh, during the period from October 2014 to March 2015.The soil of the experimental plot was silty loam in texture belonging to the Old Brahmaptura Flood Plain. The experimental area was under the sub-tropical monsoon climate, characterized by heavy rainfall during Kharif season (April to September) and scanty rainfall in Rabi season (October to March). The collected seedlings were raised at the Horticulture Farm, Bangladesh Agricultural University, Mymensingh. The size of seedbed was 3m × 1m. The experiment was undertaken to study the effects of three different levels of planting dates and four different levels of growth hormones on the growth and yield performance of cauliflower. The experiment included two factors as follows:

Factor A: Planting dates - Three dates
i. $P_1$: Planting on 1 November
ii. $P_2$: Planting on 15 November
iii. $P_3$: Planting on 1 December

Factor B: Growth hormones - Four levels
i. $H_0$: No Hormone
ii.$H_1$: 10 ppm IAA (Indole-3 Acetic Acid)
iii.$H_2$: 70 ppm $GA_3$ (Gibberellic Acid)
iv.$H_3$: 10 ppm IAA + 70 ppm $GA_3$
Thus there were 12 treatment combinations.

## Results and Discussion

The experiment was considered of three of planting dates (P) and four levels of growth hormones (H) and was designed to find out the individual and combined effects on the growth and yield of cauliflower. The results have been presented and discussed and possible interpretations are given under the following headings:

### *Plant height*

At 30, 40, 50, 60 DAT and at harvest the tallest plant 26.73, 42.67, 52.55, 60.74 and 63.26 cm was recorded from $P_2$ (planting at 15 November) and the shortest plant 24.94, 37.59, 47.31, 52.26 and 53.12 cm was observed from $P_3$ (planting on 1 December) at 30, 40, 50, 60 DAT and at harvest, respectively (Fig. 1).

At 30, 40, 50, 60 DAT and at harvest the tallest plant 27.1, 42.67, 53.12, 61.94 and 63.10 cm was found from $H_3$ (10 ppm IAA + 70 ppm $GA_3$) and the shortest plant 24.08, 37.23, 45.49, 50.07 and 52.38 cm was obtained from Ho (no hormone) respectively (Fig. 2).

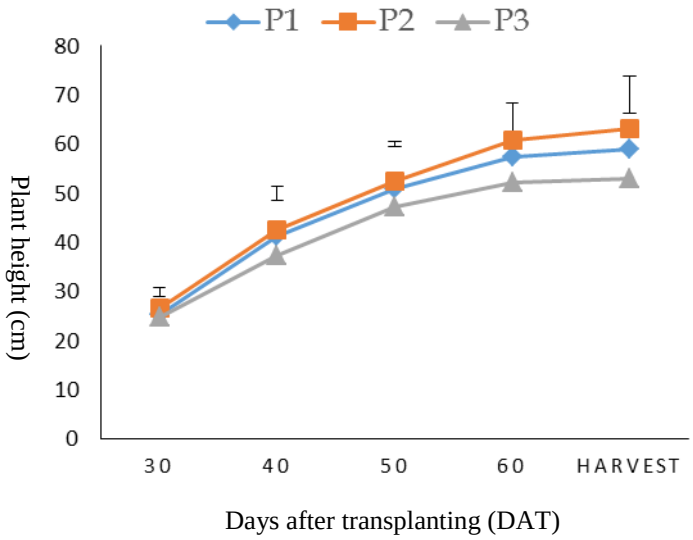


**Fig. 1**. Effect of planting date on plant height at different days after transplanting of cauliflower. The vertical bars represent LSD at 1% level of probability

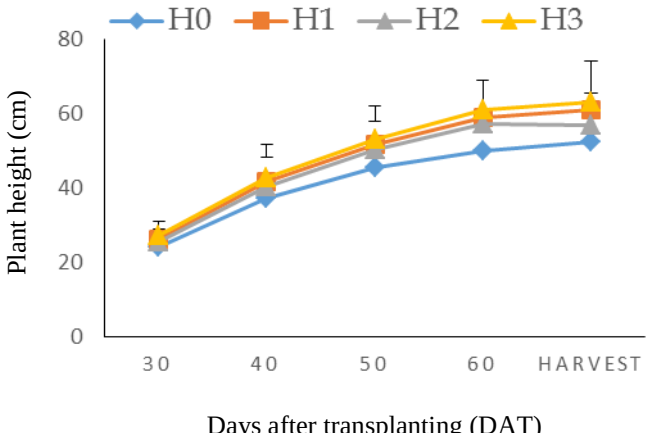


**Fig. 2.** Effect of hormone on plant height at different days after transplanting of cauliflower. The vertical bars represent LSD at 1% level of probability.

It was found that the tallest plant 27.27, 45.58, 54.96, 65.78 and 65.96 cm was found from the treatment combination of $P_2H_3$ (planting at 15 November ×10 ppm IAA + 70 ppm $GA_3$) respectively whereas the shortest plant 22.55, 31.53, 41.80, 42.75 and 45.44 cm was recorded from $P_3H_0$ (planting at 1 December × no hormone) at 30, 40, 50, 60 DAT and at harvest, respectively (Table 1).

**Table 1.** Combined effect of planting date and growth hormones on plant height of cauliflower at different days after transplanting

| Treatment | Plant height (cm) at different DAT | | | | |
|---|---|---|---|---|---|
| | 30 | 40 | 50 | 60 | Harvest |
| $P_1H_0$ | 23.61 | 38.81 | 46.95 | 51.9 | 52.71 |
| $P_1H_1$ | 24.1 | 41.58 | 49.61 | 58.2 | 57.69 |
| $P_1H_2$ | 27.04 | 40.45 | 53.36 | 58.93 | 60.51 |
| $P_1H_3$ | 26.81 | 43.77 | 53.45 | 61.17 | 64.6 |
| $P_2H_0$ | 24.09 | 41.34 | 47.73 | 55.57 | 58.99 |
| $P_2H_1$ | 24.76 | 43.16 | 52.78 | 63.85 | 62.69 |
| $P_2H_2$ | 25.79 | 40.57 | 50.74 | 57.77 | 60.38 |
| $P_2H_3$ | 27.27 | 45.58 | 54.96 | 65.78 | 65.96 |
| $P_3H_0$ | 22.55 | 31.53 | 41.80 | 42.75 | 45.44 |
| $P_3H_1$ | 24.88 | 40.32 | 49.06 | 55.03 | 58.32 |
| $P_3H_2$ | 23.43 | 39.83 | 47.37 | 55.38 | 50.31 |
| $P_3H_3$ | 26.9 | 38.68 | 50.96 | 55.89 | 58.42 |
| LSD at 5% | 0.94 | 1.46 | 1.75 | 3.50 | 3.74 |
| LSD at 1% | 1.27 | 1.96 | 2.37 | 4.76 | 5.08 |
| Significance level | ** | ** | ** | ** | ** |

**= Significant at 1% level of probability *= Significant at 5% level of probability

$P_1$: Planting on 1 November $H_0$: No Hormone

$P_2$: Planting on 15 November $H_1$: 10 ppm IAA

$P_3$: Planting on 1 December $H_2$: 70 ppm $GA_3$

$H_3$: 10 ppm IAA + 70 ppm $GA_3$

***Number of leaves per plant***

At 30, 40, 50, 60 DAT and at harvest the maximum number of leaves per plant 12.43, 15.91, 18.74, 23.40 and 24.13 was observed in $P_2$ (planting at 15 November) which was closely followed 11.95, 14.96, 18.06, 22.23 and 22.07 by $P_1$ (planting at 1 November). Again, at the same DAT the minimum number of leaves per plant 11.21, 14.25, 16.27, 19.20 and 20.23 was found from $P_3$ (planting at 1 December), respectively (Fig. 3). At 30, 40, 50, 60 DAT and at harvest the maximum number of leaves per plant 13.54, 15.68, 18.66, 23.06 and 23.66 was recorded from $H_3$ (10 ppm IAA + 70 ppm $GA_3$) which was followed 12.81, 15.35, 18.11, 22.31 and 22.84 by $H_1$ (10 ppm IAA). Again, the minimum number of leaves per plant (9.9, 14.25, 16.38, 19.41 and 19.82) was found from $H_0$ (no hormone) for the same DAT, respectively (Fig. 4).

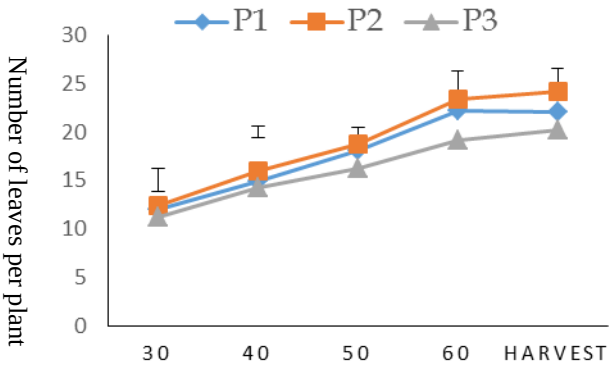


**Fig. 3.** Effect of planting date on number of leaves per plant at different days after transplanting of cauliflower. The vertical bars represent LSD at 1% level of probability

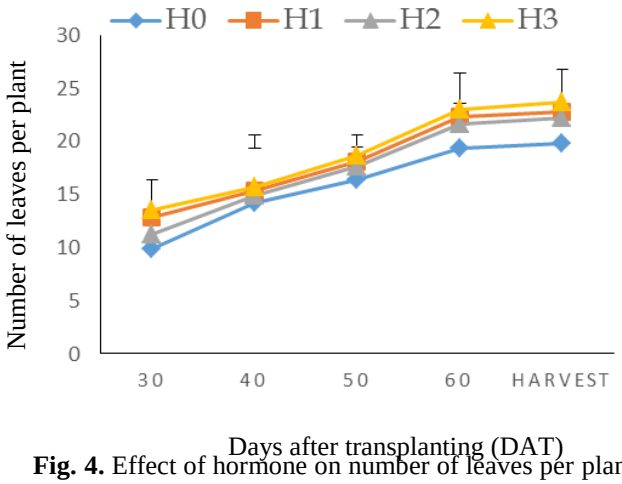


**Fig. 4.** Effect of hormone on number of leaves per plant at different days after transplanting of cauliflower. The vertical bars represent LSD at 1% level of probability

At 30, 40, 50, 60 DAT and at harvest the maximum number of leaves per plant (13.40, 17.02, 20.05, 25.38 and 26.42) was observed from $P_2H_3$ (planting at 15 November × 10 ppm IAA + 70 ppm $GA_3$) respectively, while the minimum number of leaves per plant (9.60, 13.25, 13.45, 15.29 and 17.68) was recorded from $P_3H_0$ (planting at 1 December × no hormone respectively (Table 2).

**Table 2.** Combined effect of planting date and growth hormones on number of leaves per plant of cauliflower at different days after transplanting

| Treatment | Number of leaves per plant at different DAT | | | | |
|---|---|---|---|---|---|
| | **30** | **40** | **50** | **60** | **Harvest** |
| $P_1H_0$ | 9.70 | 13.95 | 17.62 | 20.85 | 19.45 |
| $P_1H_1$ | 11.00 | 15.65 | 18.45 | 22.72 | 22.55 |
| $P_1H_2$ | 11.43 | 14.98 | 16.82 | 21.19 | 22.72 |
| $P_1H_3$ | 12.70 | 15.28 | 19.35 | 24.18 | 23.58 |
| $P_2H_0$ | 10.40 | 15.55 | 18.08 | 22.08 | 22.32 |
| $P_2H_1$ | 12.63 | 16.12 | 18.09 | 23.09 | 25.35 |
| $P_2H_2$ | 11.10 | 14.92 | 18.75 | 23.08 | 22.45 |
| $P_2H_3$ | 13.40 | 17.02 | 20.05 | 25.38 | 26.42 |
| $P_3H_0$ | 9.60 | 13.25 | 13.45 | 15.29 | 17.68 |
| $P_3H_1$ | 11.80 | 14.28 | 17.78 | 21.12 | 20.62 |
| $P_3H_2$ | 10.10 | 14.72 | 17.28 | 20.78 | 21.65 |
| $P_3H_3$ | 13.23 | 14.75 | 16.59 | 19.62 | 20.98 |
| LSD at 5% | 1.16 | 0.53 | 0.48 | 1.21 | 1.51 |
| LSD at 1% | 1.58 | 0.73 | 0.65 | 1.65 | 2.05 |
| Significance level | * | * | ** | * | * |

**= Significant at 1% level of probability *= Significant at 5% level of probability

$P_1$: Planting on 1 November $H_0$: No Hormone
$P_2$: Planting on 15 November $H_1$: 10 ppm IAA
$P_3$: Planting on 1 December $H_2$: 70 ppm $GA_3$
$H_3$: 10 ppm IAA + 70 ppm $GA_3$

**Table 3.** Effect of planting date and growth hormones on yield contributing characters of cauliflower

| Treatment | Days from transplanting to curd initiation | Days from transplanting to 50% curd formation | Days from transplanting to harvest | Stem length (cm) | Stem Diameter (cm) |
|---|---|---|---|---|---|
| **Planting date** | | | | | |
| $P_1$ | 47.06 | 51.71 | 66.45 | 9.80 | 1.40 |
| $P_2$ | 40.07 | 45.49 | 61.18 | 11.49 | 1.76 |
| $P_3$ | 42.28 | 47.62 | 63.75 | 9.03 | 1.09 |
| LSD at 5% | 1.34 | 1.43 | 1.61 | 0.37 | 0.02 |
| LSD at 1% | 1.82 | 1.94 | 2.19 | 0.51 | 0.03 |
| Significant Level | ** | ** | ** | ** | ** |
| **Growth hormone** | | | | | |
| $H_0$ | 45.97 | 50.24 | 67.41 | 9.43 | 1.35 |
| $H_1$ | 44.34 | 48.36 | 65.29 | 10.32 | 1.53 |
| $H_2$ | 41.67 | 48.14 | 62.74 | 9.53 | 1.34 |
| $H_3$ | 40.56 | 46.36 | 59.74 | 11.16 | 1.46 |
| LSD at 5% | 1.55 | 1.65 | 1.86 | 0.43 | 0.03 |
| LSD at 1% | 2.11 | 2.25 | 2.53 | 0.59 | 0.04 |
| Significant Level | ** | ** | ** | ** | ** |

**= Significant at 1% level of probability *= Significant at 5% level of probability

$P_1$: Planting on 1 November $H_0$: No Hormone
$P_2$: Planting on 15 November $H_1$: 10 ppm IAA
$P_3$: Planting on 1 December $H_2$: 70 ppm $GA_3$
$H_3$: 10 ppm IAA + 70 ppm $GA_3$

***Curd weight with leaf***

The highest curd weight with leaf 2.05 kg was obtained from $P_2$ (planting on 15 November) and the lowest curd weight with leaf 1.34 kg was recorded from $P_3$ (planting on 1 December) (Table 3).

The highest curd weight with leaf 1.88 kg was observed from $H_3$ (10 ppm IAA + 70 ppm $GA_3$) which was closely followed 1.82 kg by $H_1$ (10 ppm IAA). The lowest curd weight with leaf 1.69 kg was found from $H_0$ (no hormone) (Table 3).

The highest curd weight with leaf 2.52 kg was obtained from the treatment combination of $P_2H_3$ (planting on 15 November x 10 ppm IAA + 70 ppm $GA_3$) where as the lowest curd weight with leaf 1.01 kg was observed from $P_3H_0$ (planting 1 December x no hormone) (Table 4).

**Table 4.** Combined effect of planting date and growth hormones on yield contributing characters of cauliflower

| Treatment | Days from transplanting to curd initiation | Days from transplanting to 50% curd formation | Days from transplanting to harvest | Stem length (cm) | Stem Diameter (cm) |
|---|---|---|---|---|---|
| $P_1H_0$ | 50.56 | 54.78 | 69.8 | 8.57 | 1.59 |
| $P_1H_1$ | 46.95 | 53.22 | 63.83 | 9.98 | 1.38 |
| $P_1H_2$ | 45.79 | 51.08 | 68.6 | 9.82 | 1.48 |
| $P_1H_3$ | 44.95 | 50.78 | 63.6 | 10.85 | 1.16 |
| $P_2H_0$ | 43.62 | 47.88 | 65.83 | 11.14 | 1.72 |
| $P_2H_1$ | 41.45 | 43.42 | 66.46 | 12.31 | 1.46 |
| $P_2H_2$ | 36.28 | 45.12 | 55.93 | 9.19 | 1.9 |
| $P_2H_3$ | 35.95 | 45.55 | 56.5 | 13.35 | 1.96 |
| $P_3H_0$ | 43.79 | 51.08 | 67.8 | 8.59 | 0.74 |
| $P_3H_1$ | 44.62 | 48.45 | 65.6 | 8.67 | 1.75 |
| $P_3H_2$ | 42.95 | 47.22 | 62.5 | 9.58 | 0.84 |
| $P_3H_3$ | 37.79 | 42.75 | 59.13 | 9.3 | 1.26 |
| LSD at 5% | 2.69 | 2.86 | 3.22 | 0.75 | 0.05 |
| LSD at 1% | 3.65 | 3.89 | 4.38 | 1.02 | 0.07 |
| Significance level | ** | ** | ** | ** | ** |

**= Significant at 1% level of probability *= Significant at 5% level of probability

$P_1$: Planting on 1 November $H_0$: No Hormone
$P_2$: Planting on 15 November $H_1$: 10 ppm IAA
$P_3$: Planting on 1 December $H_2$: 70 ppm $GA_3$
$H_3$: 10 ppm IAA + 70 ppm $GA_3$

**Table 5.** Effect of planting date and growth hormones on yield contributing characters and yield of cauliflower

| Treatment | Curd weight with leaf (kg) | Pure curd height (cm) | Curd Diameter (cm) | Marketable yield (kg plant$^{-1}$) | Marketable yield (t ha$^{-1}$) |
|---|---|---|---|---|---|
| **Planting date** | | | | | |
| $P_1$ | 1.84 | 13.83 | 21.68 | 1.08 | 27.05 |
| $P_2$ | 2.05 | 14.53 | 22.25 | 1.12 | 28.11 |
| $P_3$ | 1.34 | 11.93 | 17.66 | 1.04 | 25.98 |
| LSD at 5% | 0.06 | 0.66 | 0.96 | 0.02 | 0.56 |
| LSD at 1% | 0.08 | 0.89 | 1.30 | 0.03 | 0.77 |
| Significant Level | ** | ** | ** | ** | ** |
| **Growth hormone** | | | | | |
| $H_0$ | 1.69 | 12.16 | 18.60 | 0.94 | 23.47 |
| $H_1$ | 1.82 | 14.07 | 21.35 | 1.12 | 26.95 |
| $H_2$ | 1.84 | 12.77 | 19.80 | 1.08 | 27.89 |
| $H_3$ | 1.88 | 14.71 | 22.39 | 1.20 | 29.88 |
| LSD at 5% | 0.06 | 0.76 | 1.11 | 0.03 | 0.65 |
| LSD at 1% | 0.09 | 1.03 | 1.50 | 0.04 | 0.89 |
| Significant Level | ** | ** | ** | ** | ** |

**= Significant at 1% level of probability *= Significant at 5% level of probability

$P_1$: Planting on 1 November $H_0$: No Hormone
$P_2$: Planting on 15 November $H_1$: 10 ppm IAA
$P_3$: Planting on 1 December $H_2$: 70 ppm $GA_3$
$H_3$: 10 ppm IAA + 70 ppm $GA_3$

***Pure curd height***

The maximum pure curd height 14.53 cm was recorded from $P_2$ (planting 15 November) and the minimum pure curd height 11.93 cm was found from $P_3$ (planting on 1 December) (Table 5). The maximum pure curd height 14.71 cm was recorded from $H_3$ (10 ppm IAA + 70 ppm $GA_3$) which was statistically identical 14.07 cm with $H_1$ (10 ppm IAA). The minimum pure curd height 12.16 cm was recorded from $H_0$ (no hormone) which was statistically similar 12.77 cm to $H_2$ (70 ppm $GA_3$) (Table 5).

The maximum pure curd height 14.28 cm was found from the treatment combination of $P_2H_3$ (planting on 15 November x 10 ppm IAA + 70 ppm $GA_3$) where as the minimum pure curd height (9.99 cm) was found from $P_1H_0$ (planting on 1 November x no hormone) (Table 6).

***Curd diameter***

The maximum curd diameter 22.25 cm was found from $P_2$ (planting at 15 November) which was statistically similar 21.68 cm to $P_1$ (planting on 1 November) and the minimum curd diameter 17.66 cm was obtained from $P_3$ (planting on 1 December) (Table 5).

**Table 6.** Combined effect of planting date and growth hormones on yield contributing characters and yield of cauliflower

| Treatment | Curd weight with leaf (kg) | Pure curd height (cm) | Curd Diameter (cm) | Marketable yield (kg plant$^{-1}$) | Marketable yield (t ha$^{-1}$) |
|---|---|---|---|---|---|
| $P_1H_0$ | 1.92 | 9.99 | 18.27 | 0.98 | 24.58 |
| $P_1H_1$ | 1.62 | 11.86 | 19.85 | 1.05 | 26.17 |
| $P_1H_2$ | 2.13 | 12.31 | 23.98 | 1.10 | 27.60 |
| $P_1H_3$ | 1.70 | 13.58 | 24.65 | 1.19 | 29.87 |
| $P_2H_0$ | 2.16 | 12.74 | 20.05 | 0.96 | 24.08 |
| $P_2H_1$ | 2.02 | 11.77 | 24.32 | 1.22 | 30.40 |
| $P_2H_2$ | 2.31 | 13.33 | 19.41 | 1.08 | 26.95 |
| $P_2H_3$ | 2.52 | 14.28 | 25.75 | 1.24 | 31.03 |
| $P_3H_0$ | 1.01 | 13.77 | 16.02 | 0.87 | 21.75 |
| $P_3H_1$ | 2.01 | 13.60 | 18.9 | 1.08 | 27.12 |
| $P_3H_2$ | 1.09 | 11.69 | 16.48 | 1.05 | 26.31 |
| $P_3H_3$ | 1.25 | 10.29 | 18.27 | 1.15 | 28.74 |
| LSD at 5% | 0.12 | 1.31 | 1.92 | 0.05 | 1.13 |
| LSD at 1% | 0.16 | 1.79 | 2.61 | 0.07 | 1.54 |
| Significance level | ** | * | ** | ** | ** |

**= Significant at 1% level of probability *= Significant at 5% level of probability

$P_1$: Planting on 1 November $H_0$: No Hormone

$P_2$: Planting on 15 November $H_1$: 10 ppm IAA

$P_3$: Planting on 1 December $H_2$: 70 ppm $GA_3$

$H_3$: 10 ppm IAA + 70 ppm $GA_3$

The maximum curd diameter 22.39 cm was recorded from $H_3$ (10 ppm IAA + 70 ppm $GA_3$) which was statistically identical 21.35 cm with $H_1$ (10 ppm IAA), whereas, the minimum curd diameter 18.60 cm was recorded from $H_0$ (no hormone) which was closely followed 19.80 cm by $H_2$ (70 ppm $GA_3$) (Table 5). The maximum curd diameter 25.75 cm was found from $P_2H_3$ (planting on 15 November x 10 ppm IAA + 70 ppm $GA_3$) where as the minimum curd diameter 16.02 cm was recorded from the treatment combination of $P_3H_0$ (planting on 1 December x no hormone) that is shown in (Table 6).

***Marketable yield per plant***

The highest marketable yield per plant 1.12 kg was recorded from $P_2$ (planting on 15 November) which was closely followed 1.08 kg by $P_1$ (planting 1 November) and the lowest marketable yield per plant 1.04 kg was obtained from $P_3$ (planting on 1 December) that is shown in (Table 5).

The highest marketable yield per plan. 1.20 kg was recorded from $H_3$ (10 ppm IAA + 70 ppm $GA_3$) which was closely followed 1.12 kg by $H_1$ (l0ppm IAA) and the lowest marketable yield per plant 0.94 kg was found from and $H_0$ (no hormone) (Table 5).

The highest marketable yield per plant 1.24 kg was recorded from the treatment combination of $P_2H_3$ (planting on 15 December x 10 ppm IAA + 70 ppm $GA_3$) which was statistical similar to $P_2H_1$ 1.22 kg and $P_1H_3$ 1.19 kg and the lowest marketable yield per plant 0.87 kg was recorded from $P_3H_0$ (planting on 1 December x no hormone) (Table 8).

***Marketable yield per hectare***

The highest marketable yield 28.11 t ha$^{-1}$ was observed from $P_2$ (planting on 15 November) and the lowest marketable yield 25.98 t ha$^{-1}$ was found from $P_3$ (planting on 1 December) (Table 5) and (Fig. 5).

The highest marketable yield 29.88 t/ha was obtained from $H_3$ (10 ppm IAA + 70 ppm $GA_3$) which was closely followed (27.89 t ha$^{-1}$) by $H_2$ (70 ppm $GA_3$) (Table 5) and (Fig. 6).

The highest marketable yield 31.03 t ha$^{-1}$ was observed from $P_2H_3$ (planting 15 November x 10 ppm IAA + 70 ppm $GA_3$), while the lowest marketable yield 21.75 t ha$^{-1}$ was found from $P_3H_0$ (planting on 1 December x no hormone) (Table 6) and (Fig. 7).

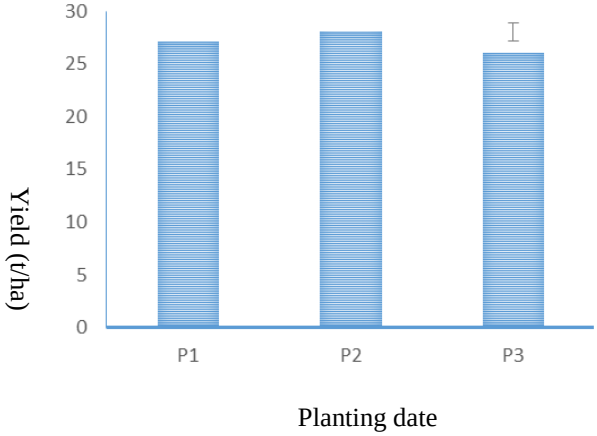


**Fig. 5.** Effect of planting date on yield per hectare of cauliflower. The vertical bar represents LSD at 1% level of probability

$P_1$: Planting on 1 November; $P_2$: Planting on 15 November; $P_3$: Planting on 1 December

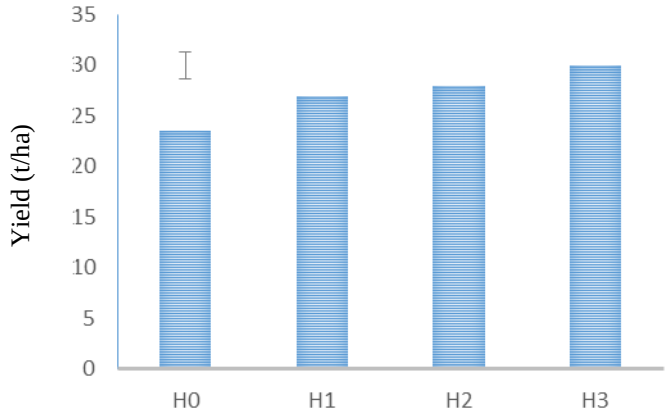


**Fig. 6.** Effect of growth hormone on yield per hectare of cauliflower. The vertical bar represents LSD at 1% level of probability

$H_0$: No Hormone $H_1$:10 ppm IAA
$H_2$: 70 ppm $GA_3$ $H_3$: 10 ppm IAA + 70 ppm $GA_3$

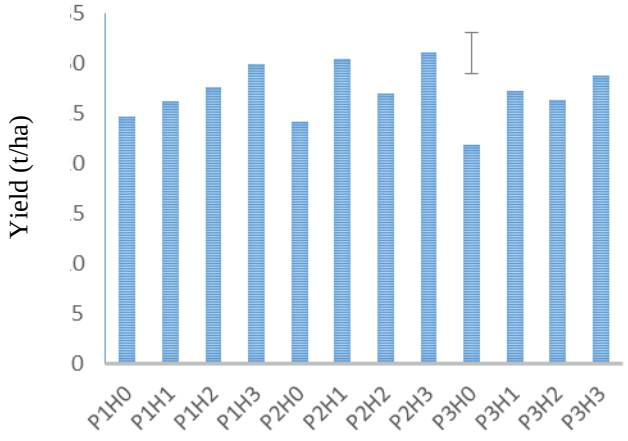


**Fig. 7.** Combined effect of planting date and growth hormones on yield per hectare of cauliflower. The vertical bar represents LSD at 1% level of probability.

$P_1$: Planting on 1 November $H_0$: No Hormone
$P_2$: Planting on 15 November $H_1$:10 ppm IAA
$P_3$: Planting on 1 December $H_2$: 70 ppm $GA_3$
$H_3$: 10 ppm IAA + 70 ppm $GA_3$

## Conclusions

From the present experiment it is clear that growth and yield of Cauliflower largely depend upon the planting date and growth hormone. These two factors either singly or in combination influence the growth, quality and yield of the crop. In this experiment, the highest yield per hectare was obtained from the combination with planting on 15 November x 10 ppm IAA + 70 ppm $GA_3$. On the other hand, the lowest yield per hectare was obtained from the combination with planting on 15 December x No hormone.

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