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# Effect of Different Plant Spacing on the Production of Hybrid Cauliflower (*Brassica Oleraceae Var. Botrytis*) Under the Agro-Climatic Conditions of Mid-Hills Region Nepal

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## Abstract

A field experiment was conducted at Farmer's field in Banepa, Kavreplanchowk District during the spring season, 2015 to find out the optimum plant spacing on cauliflower production. Four plant spacing viz. (i) 45×45 cm in single row spacing, (ii) 52.5×45 cm in double row spacing, (iii) 52.5×30 cm single row spacing and iv) 52.5×30 cm in double row spacing were included in the study. Different spacing significantly influenced yield and yield contributing characters. 52.5×45 cm in double row spacing showed the best response for all the parameters. Maximum plant height (31cm), curd diameter (18 cm), maximum curd weight (682 g plant-1) and yield (17.3 t ha-1) were recorded in the plots where the plants were spaced 52.5×45 cm apart single row spacing.

**Keywords:** Cauliflower Production; Spacing, Cruciferacea; Average Yield; Plant Competition

## Introduction

The global issue is now to increase crop productivity to meet the food demands of the increasing population of the world [1]. Cauliflower is an economically important winter vegetable of Nepal. It is nutritionally rich and has medicinal value [2,3]. The agro-climatic conditions across the country favor the production of cauliflower even in the summer season with export potentiality. It covers a total area of 29,836 ha and total production of 399,012 tones (VDD, 2010) with the productivity of 7.47 tonne per hector. The average yield produced in Nepal is far below than the yield in other countries. This low yield may be due to the improper agronomic practices or use of improper spacing of cauliflower. The potential yield of cauliflower (Brassica oleraceae var. Botrytis) is determined by appropriate husbandry practices and the surrounding environment provided to the crop. Among the husbandry practices, a direct effect can be observed due to an increase or a decrease in plant population because a cauliflower plant bears a single curd. However, serious thoughts have not been given in this aspect in Nepal [4-6]. There are different spacing given by different institution for improved and hybrid cauliflower and cabbage production in Nepal [7]. Its cultivation in Nepal has not extended due to the lack of awareness regarding its appropriate method of planting including planting time and spacing. The current study was conducted to observe the effect of different spacing on the growth and yield of cauliflower variety under investigation (Silver cup-60).

## Materials and Methods

### Site description

The research was carried out to study the effect of different plant spacing on the production of Cauliflower (*Brassica olearacea L. botrytis*) was cultivated in the spring season of 2015. The experiment was carried out in a farmer's field located in Budol, Banepa, Kavreplanchowk at latitude 27° 38' 0" N and longitude 85° 31' 0" E and 1550 m above sea level.

### Design of experiment

The research was laid out in simple Randomized Complete Block Design (RCBD) with three replications in plot size 3.15×2.25 $m^2$. Seeds of a cauliflower variety Silver cup-60 were sown in the nursery in a well-prepared seedbed (size: 1×3 m) and were covered with the dry straw and maintained in the plastic tunnel. Hand sprinkler watered the beds just after the seed sowing. Transplantation was done on 10th May on one side of the ridge with the selected plant spacing. The field was flooded immediately after transplantation. The amounts of fertilizers applied (kg/ha) was as follows: 200:120:100kg NPK/ha+FYM-Trichoderma virideae (TV) @200gm/plant+FYM-EM @300gm/plant+ Compost @ 100 gm/pit and Boron 2 kg/ha. A total amount of DAP, compost, FYM, and boron was applied in the plot during final land preparation as a basal dose. The top dressing of Urea and MoP were applied 15 days after planting. Irrigations were provided when necessary. Two hand weeding was performed after planting.

### Treatments Detail

$T_1$=45×45 cm single row spacing, $T_2$=52.5×45 cm double row spacing, $T_3$=52.5×30 cm double row spacing and $T_4$=52.5×30 cm single row spacing.

### Parameters recorded

Three plants per plots were selected randomly for data collection. The data for the following parameters were recorded during the study. Mortality percentage, days taken to 1st curd appearance, plant height (cm), the total number of leaves per plant, curd diameter (cm), the weight of curd per plant (kg) and yield per hectare. Harvesting was done at 4-5 days interval throughout the harvesting season.

### Plant protection

Botanicals @1:8 water ratio at 14 DAT and 25 DAT respectively and Astha Killer (Chloropyriphus 50%+ Cypermethrin 5%) in 32 DAT @1.5 ml/ltr of water.

### Analysis of the data

The statistical analysis was performed by using MS Excel and SPSS.

## Results and Discussions

### Effect of spacing on cauliflower production

**Plant height (cm):** Significant differences were recorded for the height of the plants. $T_2$ (52.5×45 cm) produced the tallest plants (31cm). Minimum height (26.8 cm) was noted in $T_4$ (52.5×30 cm). $T_1$ (35 cm) and $T_3$ (29.4 cm) produced shorter plants and all these treatments showed non-significant behavior and were statistically at par with each other. The increased plant height of cauliflower during this study might be due to the larger plant spacing which will be significant only up to an absolute limit. Moreover, Mujeeb-ur-Rahman et al (2007) reported the wide spacing resulted in the tallest plant height and was due to lesser competition for nutrients, moisture, and $CO_2$ among the roots of the plants [8-13]. In contrary to this, smaller spacing created more competition for the resources in the roots of plants and resulted in lower plant height. Khatiwada (2000) also reported the taller height of cabbage under greater spacing [7].

**Total leaves per plant:** The overall numbers of leaves followed the similar trends to plant height. $T_2$ (52.5×45 cm) showed maximum leaves (23) and proved that 52.5×45 cm spacing was the more suitable spacing for cauliflower production. Statistically, $T_3$ (52.5×30 cm), $T_1$ (45×45 cm), and $T_4$ (52.5×30 cm) showed similar results and were at par with each other by producing 22.0, 21.0 and 20.0 leaves per plant respectively. The higher numbers of leaves in 52.5×45 cm spacing might be due to more availability of resources for the growth and development of the leaves. The more space also provides the better exposure to plants for photosynthesis. Masood *et al.* (2003) also reported more numbers of leaves at 45 cm spacing of canola [14].

**Mortality percentage:** Those plants, which died after transplantation was counted and their percentage was calculated. Maximum mortality (35.12%) rate was recorded in $T_3$ (52.5×30 cm spacing), which was statistically at par with $T_4$ (52.5×30 cm) and $T_1$ (45×45 cm), as shown in Table 1. $T_2$ (52.5×45 cm) showed the lowest mortality rate (15%). The lower mortality in higher spacing might be due to the availability of adequate resources such as nutrients, sunlight, moisture and carbon dioxide in the plant canopy of cauliflower plants. Mujeeb-ur-Rahman *et al* (2007) also reported the lower mortality of cauliflower transplanting in the spacing of 45 cm [8].

**Curd diameter (cm):** Curd diameter is a significant yield component in cauliflower. Greater the diameter of curd represents the higher yield of the crop. A highly significant data regarding the curd diameter showed the supremacy of $T_2$ (52.5×45 cm) amongst all the other plant spacing, as it produced the maximum curd diameter (18 cm), which was very closely followed by $T_3$ (52.5×30 cm) with a diameter of 17.3 cm which is significantly similar with $T_4$ (17.2). However, minimum curd diameter (16.1 cm) was recorded in $T_1$ (45×45 cm). The closer plant spacing showed poor results due to close competition for acquiring the nutrients,

sunlight, and space for better curd growth and development. Oad *et al* (2002) also reported that narrow plant spacing resulted in the poor plant qualities [15-17].

**The Weight of curd per plant (kg):** The curd is the economically and nutritionally important part of cauliflower used in the human consumption. Significant variations were observed for the weight of curd per plant. Maximum curd weight (682 g) was recorded in $T_2$ (52.5×45 cm) double row, followed by 672 g and 635 g curds obtained from $T_3$ (52.5×30 cm) single row and $T_4$ (52.5×30 cm) double row spaced plants. Minimum curd weight 502 g was noted in $T_1$ (55×45 cm) single row. More weight gain by $T_2$ might be due to the proper utilization of accumulates which were conserved by the plant, which were optimally spaced. The results are in line with the previous findings of Oad *et al.* (2002) who recommended 45 cm plant spacing as the most successful plant spacing for getting the higher yield of cauliflower, whereas the narrow plant spacing could not record satisfactory plant characteristics [15].

**The Yield of curd per hectare (tons):** Yield and yield attributing characters of cauliflower were significantly influenced by the time of sowing (Table 1). The cauliflower yield increased with an increase in plant spacing up to an absolute limit, and after 45 cm spacing, it started decreasing. Maximum yield (17.3 t ha-1) was recorded from $T_2$ (52.5×45 cm) double row followed by $T_3$ (52.5×30 cm) single row, which produced the yield of 17 t ha-1, both were statistically the same. The lowest yield was recorded as 14.4 tonnes and 12.5 tonnes per hectare in $T_4$ (52.5×30 cm) single row and $T_4$ (52.5×30 cm) respectively. Low yield in case of close spacing might be due to the higher mortality rate, lower plant height and lesser numbers of leaves per plant, shorter diameter of curd and also the competitive growth of the plants. These results agreed with the findings of Sharma and Arora (1984), Islam *et al.* (2002), Oad *et al.* (2002) and Masood *et al.* (2003) who recommended 45 cm plant spacing as the best spacing for getting the higher yield [18-20].

| Spacing (cm) | No of leaves per plant | Plant height (cm) | Canopy diameter (cm) | Diameter of head(cm) | Single head weight (g) | Average yield per plot(t/ha) |
|---|---|---|---|---|---|---|
| **45×45** | 21 | 27.6 | 39 | 16.1 | 502 | 14.4 |
| **52.5×45** | 23 | 31.3 | 39.5 | 18 | 682 | 16.8 |
| **52.5×30** | 22 | 29.4 | 39 | 17.3 | 672 | 17.3 |
| **52.5×30** | 20 | 26.8 | 45.3 | 17.2 | 635 | 12.5 |
| **CV%** | 2.9 | 3.6 | 3.2 | 4.8 | 6 | 4 |
| **$LSD_{(0.05)}$** | 0.086 | 0.045 | 0.035 | 0.067 | 0.054 | 0.064 |

**Table 1:** Effect of sowing on yield of cauliflower

## Physiological disorders

Major physiological disorder seen in the study was boron deficiency and blindness. Boron deficiency was seen in nearly 5% of total plants, and blindness was seen in almost 1% of entire plants. The causes of boron deficiency in the plants might be due to the soil quality of the cauliflower growing field having the lower concentration of the boron.

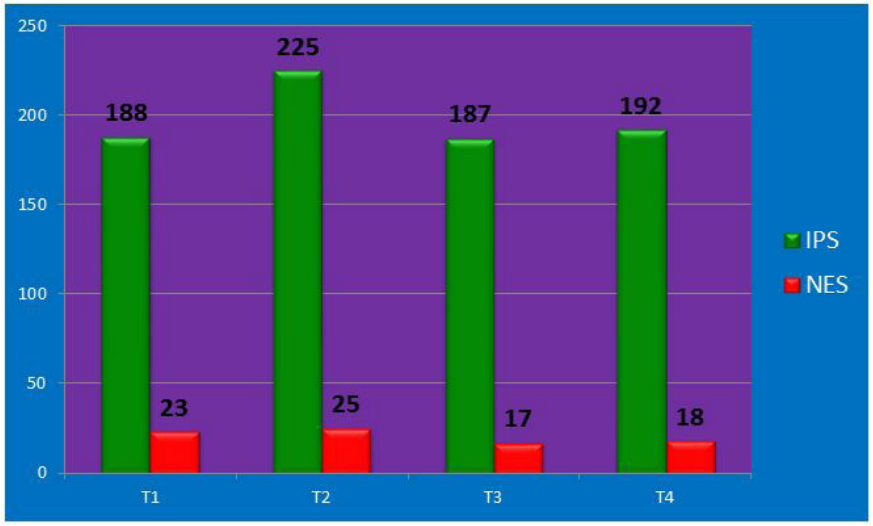


**Figure 1:** Level of IPs and NEs in different treatments under different spacing

# Conclusion

Plant spacing is an essential factor in the growth and yield of cauliflower. Amongst various spacing, 52.5×45cm in double row spacing proved better results in all the aspects. As a result, showed that 52.5×45 cm plant spacing excelled in almost all parameters. This means that any increase or decrease within 45 cm plant spacing will have an adverse or decreasing effect of the growth and yield of cauliflower.

## Recommendations

Increasing the plant spacing will results in lower the yield and on the other hand if the plant spacing is decreased and the number of plants increased but the competition amongst these high number of plants may cause less curd diameter, the weight of curd and hence the yield may be lowered. Therefore, we suggest 45 cm plant spacing as an optimum spacing, which produced a high number of heads as well as a higher yield of cauliflower.

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