



## EFFECT OF PLANTING DATE AND VARIETY ON GROWTH AND YIELD OF BROCCOLI DURING THE DRY SEASON IN SOUTHERN THAILAND

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**ABSTRACT:** The effects of planting dates and varieties on broccoli (*Brassica oleracea* L. var. *italica* Plenck) growth and yield were studied at Prince of Songkla University, Hat Yai, Songkhla province, southern Thailand. The trial was aimed to select the suitable planting dates and broccoli varieties for commercial production during the dry season. Split-plot in randomized complete block design was used in this experiment with four replications. From January to June, the Top Green, Green Queen and Yok Kheo had seedling survival rates of 76.53-100.00% except the Special. The Yok Kheo had the highest total yield of 12.31 and 10.65 t.ha<sup>-1</sup> when the planting in January and March, respectively. The Yok Kheo is an interesting new hybrid variety which producing the yield higher than the Top Green which is popular variety grown in southern Thailand. The yield of the Green Queen was not significantly different from the Top Green. It can be harvested at 11.67 and 9.38 days earlier than the Top Green and Yok Kheo, respectively.

**Keywords:** *Brassica oleracea* L. var. *italica* Plenck, planting date, growth and yield, dry season, southern Thailand

### INTRODUCTION

Broccoli is a member of the Brassicaceae family. Other members of the family include cauliflower, cabbage and kale. Broccoli is considered as cool-season crops. Its optimum growing temperature is in the range between 16 and 20°C [3]. Broccoli has become popular in Thailand as cooked vegetable because of its delicious taste and highly nutritional value. It is generally planted in highland where the weather is cool or in the lowlands during the cool season [6]. Broccoli has commercially potential vegetable crop that can be planted for commercial production in Songkhla province of southern Thailand. However, the selection of varieties and planting dates is crucial for successful cultivation because the weather of southern Thailand is quite humid tropics and suitable for the heat of tolerant hybrid varieties which are better adapted to the high temperature of the humid tropics allowing grow and produce high yields during the hot season [5]. The objective of this study was to investigate the effects of planting dates and varieties on the growth and yield of broccoli during the dry season in Songkhla province of southern Thailand.

### MATERIALS AND METHODS

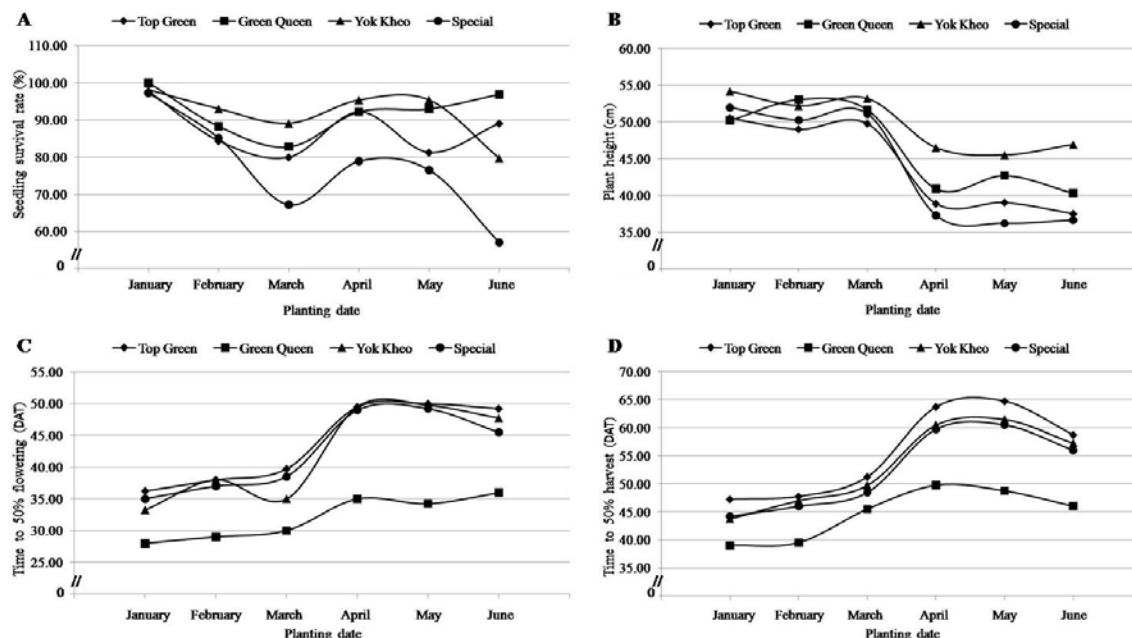
This study was conducted at Prince of Songkla University, Hat Yai, Songkhla province, Thailand (Latitude 7° 00' 14.20" N Longitude 100° 30' 1.75" E Altitude 56 m above the sea level) from January to June, 2011. The design was a split-plot in a randomized complete block. The main plots were planting dates: January, February, March, April, May and June with sub-plots being early varieties of broccoli: Top Green, Green Queen, Yok Kheo and special. These varieties show good performance such as, early growth and yield when planting in Songkhla province [5]. Broccoli seed was sown in plastic baskets (13×16×4 inches). When the first true leaf had emerged, the seedlings were transplanted into 2 inch pots. At the fourth leaf stage, the seedlings were transplanted in to the field. The plot size was 1×5 m. The plant and row spacing were 0.30×0.60 m and the edge spacing was 0.2 m. Each plot had 2 rows of 32 Plants. The broccoli was regularly watered with a sprinkler early in the morning and early in the afternoon except rainy days. Fertilizer 21N-0P-0K was applied 3 times, at 2, 3 and 4 weeks after transplanting. Moreover fertilizer 15N-6.5P-12.5K was applied twice, at 5 and 6 weeks after transplanting. All plots were weeded with a hand hoe, twice, at 2 and 4 weeks after transplanting.

The measured data, seedling survival rate (%) at 30 DAT (i.e., days after transplanting) was determined. The number of days from transplanting to the beginning of time to 50% flowering and harvest was observed in the plot.

At time to 50% flowering, plant height (cm) was measured for 10 random plants in the plot by taking the distance from the soil surface to the longest top leaf. Other data were recorded from harvested plants in the plot: harvested plant (%), head diameter (cm), head weight (g/plant) and total yield (t.ha<sup>-1</sup>). Data of average daily rainfall, minimum and maximum temperatures from January to June, 2011 was received by the Kho Hong Agrometeorological Station, Hat Yai, Songkhla province, Thailand. All data were analyzed using the analysis of variance and means separated by Duncan's multiple range test (DMRT) at the 5% level of significance.

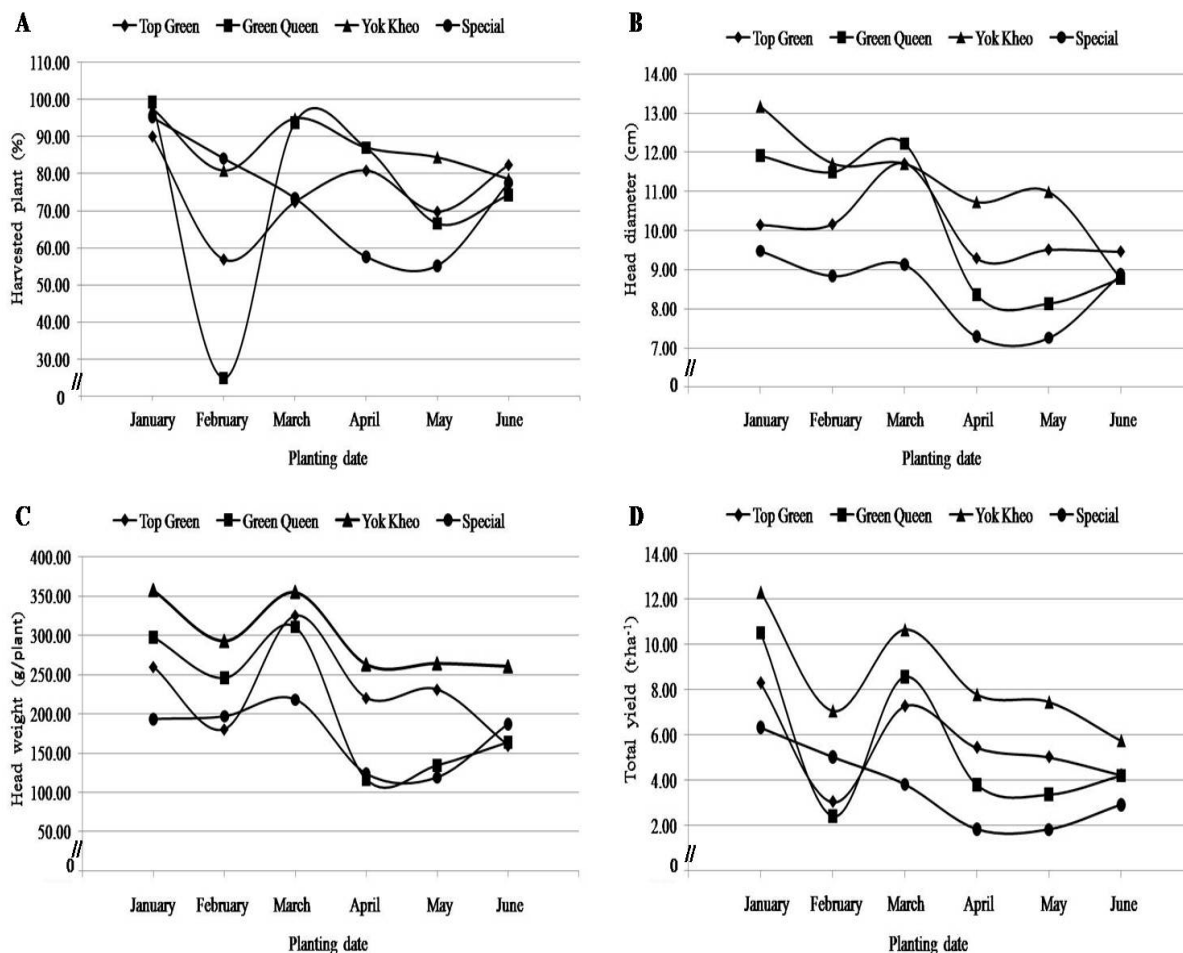
## RESULTS AND DISCUSSION

**Growth responses:** The effects of planting dates and varieties on growth of broccoli are presented in Figure 1. The interaction effect for seedling survival rate is differed from each variety over the range of planting dates (Figure 1A). The four varieties had highly seedling survival rates when planting from January to June except the Special, decreasing survival rate of seedling when specifically planting in March and June. Due to after transplanting, it had heavy raining and the maximum temperature of 31.67-34.20°C (Figure 3) that was affected on seedling survival rate of the Special while three varieties had been less affected. It depended on the characteristics of the broccoli variety [5]. There were significant differences for plant height for planting dates and varieties, as well as a significant interaction effect. The Yok Kheo had the highest plant height when planting in January, significantly indifferent from that of the Top Green, Green Queen and Special. After March, plant height of each variety was decreased until June (Figure 1B) because these periods had maximum temperatures between 32.75 and 34.20°C (Figure 3) that could reduce the growth rate. Decreasing growth rate of broccoli occurred under maximum temperatures between 30 and 40°C [4]. The interactions between planting dates and varieties were significantly influenced on the time to 50% flowering and harvest. The Green Queen had the early time to 50% flowering when planting on January (28 DAT). It was late produced time to 50% flowering after February (30.00-36.00 DAT), but produced much earlier flowering than the Top Green, Yok Kheo and Special given flowering with February to June (35.00-49.25 DAT). Especially, after March (Figure 1C). These results are consistent with time to 50% harvest showing that the Green Queen had given the earlier time to 50% harvest (39.00- 39.50 DAT) when planting in January and February, but the time was to 50% harvest after the February (40.45-58.75 DAT). The Top Green, Yok Kheo and Special were late to 50% harvest than the Green Queen (43.75-64.75 DAT) with January to June. Particularly, after the March (Figure 1D). The early yield harvesting has a great impact on them marketing because of the higher prices [7]. In April to June, the time to 50% flowering and harvest of the four varieties were delayed compared with broccoli planted from January to March because of the hot season of southern Thailand. The climate was dry and hot, therefore the growth rate of broccoli was decreased [8], resulted in the time to 50% flowering and harvest of broccoli delayed.

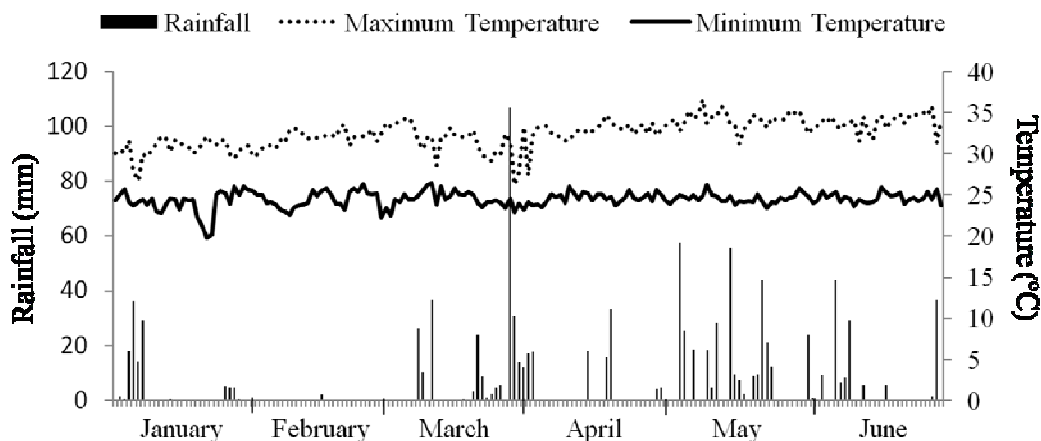


**Fig. 1** Significant and meaningful interactions between planting date and variety on: (A) seedling survival rate (%); (B) plant height (cm); (C) time to 50% flowering (DAT); (D) time to 50% harvest.

**Yield responses:** There were interaction effects of planting dates and varieties. The Green Queen had the highest harvested plant of 99.22% that was not significantly different from the Top Green, Yok Kheo and Special (92.03-95.23%) when planting in January, but the Green Queen had given lower harvested plants than three varieties: the Top Green, Yok Kheo and Special when planting in February and continuously increasing later (Figure 2A). The interactions between planting dates and varieties were significantly influenced on each particular head's diameter and weight. The highest head diameter and weight obtained by the YokKheo with January's planting (13.18cm and 357.55 g/plant, respectively). The Yok Kheo had decreased yield's attributes in February and increased after March, as well as other varieties. The Special had the lowest head diameter and weight compared with the Top Green, Green Queen and Yok Kheo, but it had increased head diameter and weight in the June (Figure 2B, C). The effects of planting dates and varieties on total yield of broccoli are presented in Figure 2D. The interaction effect for total yield was differed from each variety over the range of planting dates. The Yok Kheo had the highest total yield (12.31 and 10.65t $ha^{-1}$ , respectively), followed by the Green Queen and Top Green (10.50 and 8.29 t $ha^{-1}$ ) when planting in January and March. The Special had lowest total yield compared with other varieties that had decreased yield after January. The Yok Kheo, Green Queen and Top Green had the decreased the yield in February and increasing after March to June except the special. These periods had maximum temperatures about 32.75-34.20°C (Figure 3). Maximum temperatures of about 31-35°C resulted in the incomplete development of broccoli heads and yields were decreased [2]. Broccoli heads were rapidly developed and showed a small head diameter and decreased yield under a maximum temperature about 30 to 40°C [4]. In February, it had the same climate as January and March, but the broccoli produced low yield because this period had heavy raining during the yield harvesting period. The broccoli was infected with head rot from the impact of rain drops [8], and destruction was caused by the bacterium *Erwinia carotovora* ssp. *carotovora* that causes soft rot disease in broccoli [1].



**Fig. 2** Significant and meaningful interactions between planting date and variety on: (A) harvested plant (%); (B) head diameter (cm); (C) head weight (g/plant); (D) total yield (t $ha^{-1}$ ).



**Fig.3 Daily rainfall, minimum and maximum temperatures during January to June, 2011 growing seasons from Kho Hong Agrometeorological Station at Hat Yai, Songkhla province, southern Thailand.**

## CONCLUSION

The results showed that January and March are better optimum time for broccoli production in Songkhla province of southern Thailand compared with February, April, May and June. The Yok Kheo, Green Queen and Top Green are the suitable broccoli varieties for production in Songkhla province of Southern Thailand when it is planted at appropriate time. Especially, the Yok Kheo can be given high yield even it was planted in the dry season (April to June).

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