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Research article

EFFECT OF SHADING ON INCIDENCE OF BLACK ROT DISEASE AND YIELD QUALITY OF BROCCOLI IN HUMID TROPICAL REGIONS OF THAILANDKaristsapol Nooprom^{1*}, Quanchit Santiprachha¹ and Sompong Te-chato¹¹Department of Plant Science, Faculty of Natural Resources, Prince of Songkla University, Hat Yai, Songkhla, 90112, Thailand

*Corresponding author, e-mail: abhichard_n@hotmail.co.th

ABSTRACT: The study was carried out in the experimental location of Department of Plant Science, Faculty of Natural Resources, Prince of Songkla University, Thailand, from April to June, 2012. Split-plot in randomized complete block design was used in this experiment with four replications. The broccoli plants under the shading had the lowest incidence of black rot disease (14.48%) which was significantly lower than the full sunlight (76.91%). There was a positive impact of the shading on yield quality of the broccoli. The Yok Kheo had the highest head length and diameter (39.13 cm and 12.11 cm, respectively) when planting under the shading. These results consistent with broccoli total yield, the highest total yield was obtained from the Yok Kheo under the both shading and full sunlight (10.92 t ha⁻¹ and 8.29 t ha⁻¹, respectively), followed by the Green Queen under the shading (6.21 t ha⁻¹). Therefore, the appropriate variety for planting during dry season in humid tropical regions of Thailand was the Yok Kheo and Green Queen because its total yield per hectare was higher than of the Top Green and they also had higher quality of head.

Keywords: Broccoli, Shading, Humid tropical climate, Black rot disease.

INTRODUCTION

Broccoli belongs to the *Brassica*, which includes a wide range of crop plants derived from the Mediterranean sea cabbage and modified over the years by selection and breeding. Broccoli (*Brassica oleracea* var. *italica*) is one of the major crop plants in this genus (Uzun and Kar, 2004) that includes cauliflower (*Brassica oleracea* var. *botrytis* L.), cabbage (*Brassica oleracea* var. *capitata* L.) and kale (*Brassica oleracea* var. *acephala* DC.) Broccoli is considered as cool-season crops. Optimum temperature requirement is in the range of 16 to 20°C (Decoteau, 2000). It is one of the most important and popular vegetable crops in many countries of the world because of its good organoleptic properties and high nutritive values (Diputado, 1989). Broccoli is vitamin rich vegetable. It is fairly rich in carotene and ascorbic acid and contains appreciate quantities of thiamin, riboflavin, niacin and iron (Thompson and Kelly, 1985). Black rot is one of the serious diseases at seedling and planting stage, and the infection resulting from infected seeds (Dutta et al., 2011). It caused by *Xanthomonas campestris* pv. *Campestris*. Bacterium colonizes in the vascular system and the characteristic black rot system is V-shaped lesion at leaf margins with black veins, chlorosis and necrosis (Kocks and Zadoks, 1996). Broccoli has commercially potential vegetable crop that can be grown for commercial production in southern Thailand where has a humid tropical climate (Nooprom et al., 2013) that caused appropriate environment for spreading of black rot disease include high temperature and humidity that affect broccoli growth and yield quality losses (Vudhivanich, 2006). The objective of the current study was to investigate the shading and yield in incidence of black rot disease and yield quality of broccoli for commercial production in humid tropical regions of Thailand.

MATERIALS AND METHODS

This study was conducted at Prince of Songkla University, Hat Yai, Songkhla, Thailand (Latitude 7° 00' 14.20" N Longitude 100° 30' 1.75" E Altitude 56 m above the sea level) from April to June, 2012. The experimental design was split-plot in a randomized complete block design (RCB). The main plots were two treatments: full sunlight and shading by green shade net with sub-plots being varieties: Top Green, Green Queen and Yok Kheo. These varieties show good performance such as, early growth and yield when growing in Songkhla of southern Thailand (Nooprom et al., 2011). 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 on the field. The plot size was 1×5 m and the plant spacing was 30 cm and row spacing was 60 cm.

The broccoli was regularly watered with a sprinkler early in the morning and early in the afternoon. Fertilizer 21N-0P-0K was applied three 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.

RESULTS AND DISCUSSION

Effect of shading on the environmental variables: Light intensity (Figure 1A) and maximum temperature (Figure 2) of experimental location under the shading were lower than under the full sunlight. In contrast, the relative humidity of the air of experimental location under the shading was higher than under the full sunlight (Figure 1B).

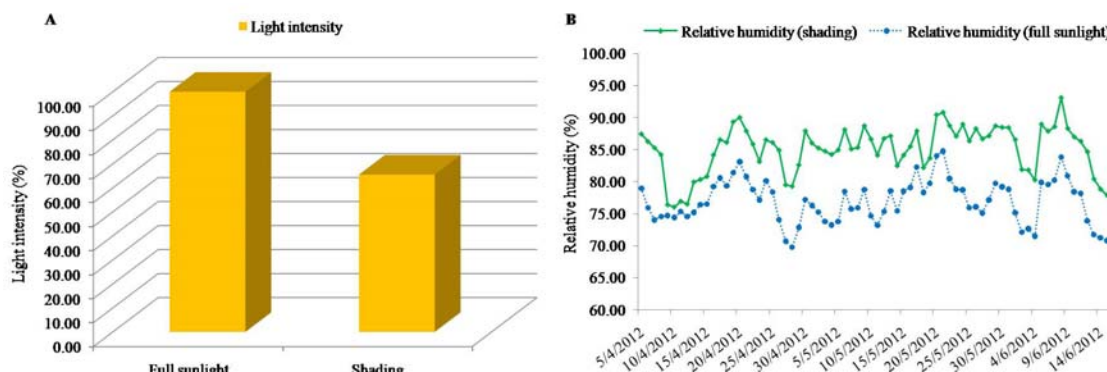


Figure: 1 Data of light intensity (A) and daily relative humidity (B) in experimental location, Department of Plant Science, Faculty of Natural Resources, Prince of Songkla University during April to June, 2012.

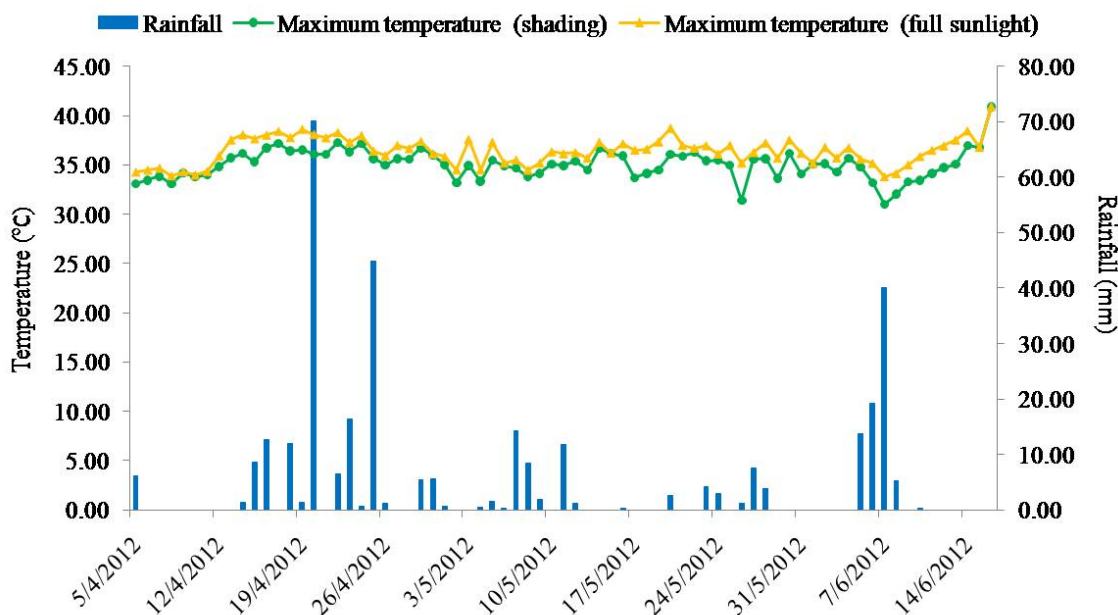


Figure: 2 Daily maximum temperatures (A) and rainfall (B) in experimental location, Department of Plant Science, Faculty of Natural Resources, Prince of Songkla University during April to June, 2012.

Effect of shading on incidence of black rot disease: Result in Figure 3 showed that broccoli plants under the shading had lower incidence of black rot disease (14.48%) than the full sunlight (76.91%). The highest incidence rate was observed in the Top Green (56.09%), followed by the Green Queen and Yok Kheo (44.75 and 36.27 %, respectively) which was not significantly different ($P \leq 0.05$).

The interactions between treatments and varieties were significantly influenced on the black rot disease incidence. The Yok Kheo and Green Queen under the shading were observed with the lowest disease incidence (9.41 to 10.13%) as shown in Figure 3A. Disease incidence declined under the shading because the environment under the shading had the decreasing maximum temperature (2.84 to 3.63°C). The highest disease incidence was obtained from the Top Green and Green Queen when planting occurred under the full sunlight (79.30 to 88.29%, respectively). Incidence of black rot disease increased when planting under the full sunlight because there were maximum temperature (33.84 to 40.92°C) and continuous raining (Figure 2) that were appropriate for black rot disease spreading. Black rot disease well spreaded when it obtained high temperature about 15 to 35°C (Vudhivanich, 2006). This result was also similar to Schaad and Thaveechai (1983) and Dutta et al., (2011) that humid tropical climate had suitability on black rot disease spreading.

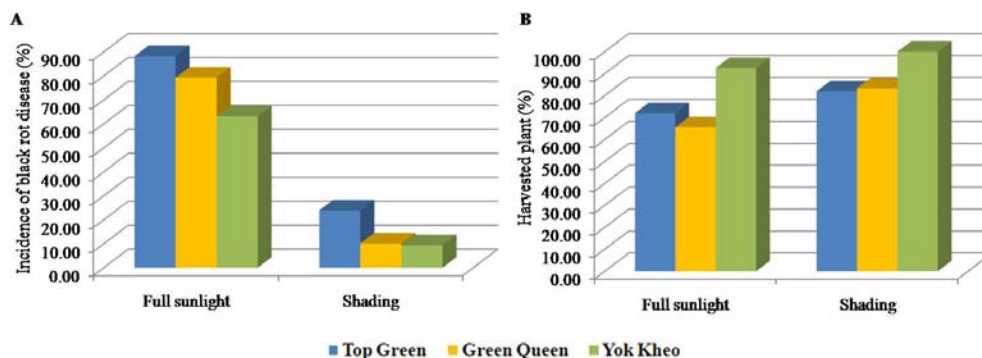


Figure: 3 Interactions between treatments and varieties on: incidence of black rot disease (A) and harvested plant (B).

Effect of shading on broccoli yield quality: There were interaction effects of treatments and varieties. Broccoli planting under the shading had higher harvested plant than under the full sunlight as shown in Figure 3B. The Yok Kheo had the highest harvested plant (100%), followed by the Top Green and Green Queen (81.98 to 83.36%). The interactions between treatments and varieties were significantly influenced on each particular head length and diameter. Under the shading, the three varieties had higher head length and diameter than under the full sunlight (39.09 cm and 11.26 cm, respectively). The highest head length and diameter were obtained in the Yok Kheo (39.13 cm and 12.11 cm, respectively) when planting under the shading (Figure 4A and B, respectively) while Green Queen had the lowest head length and diameter (31.46 cm and 9.97 cm, respectively). These results are consistent with head weight and total yield of the three varieties.

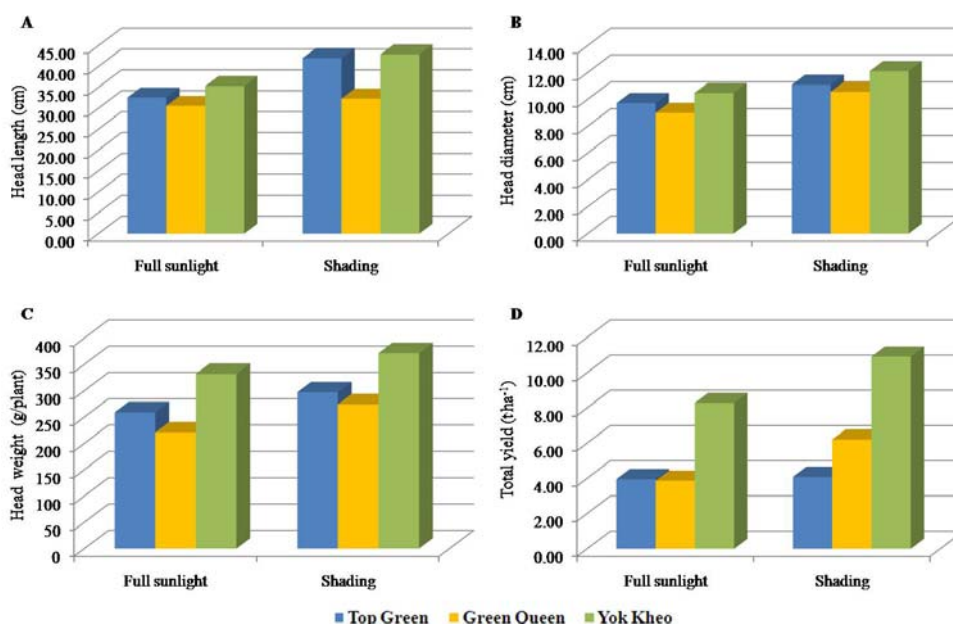


Figure: 4 Interactions between treatments and varieties on: head length (A), head diameter (B), head weight (C) and total yield (D).

The highest head weight and total yield obtained from the Yok Kheo (371.48 g/plant and 10.92 t ha^{-1}) when planting under the shading (Figure 4C and D, respectively). The Green Queen had the lowest head weight and total yield (220.76 g/plant and 3.87 t ha^{-1}). Broccoli plants under the shading had high total yield because the research field under the shading had lower maximum temperature than under the full sunlight (2.84 to 3.63°C) as shown in Figure 2 and increasing relative humidity (8.15%) as shown in Figure 1B. These results are also similar Phuwiwat and Masari's (2001) which the Fuji cauliflower planting under the 28.37% shading had higher weight than the Full sunlight. The high light intensity can be plant's growth rate and yield losses (Nooprom et al., 2013).

CONCLUSION

Our study showed that the shading had suitability for broccoli planting during dry season in humid tropical regions of Thailand because of the decreasing light intensity and average maximum temperature, and the decreasing incidence of black rot disease and increasing yield quality of broccoli. The appropriate broccoli variety was the Yok Kheo and Green Queen because its total yield per hectare was higher than of the Top Green and they also had higher quality of head.

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