



## Evaluation of effect of colored shade nets on plant growth and fruit yield of high bush blueberry in Yingyu County

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### Abstract

Little research has been done on blueberry under shade nets in northeastern china. We used two color nets black and green with three different level of shade 30%, 50%, 70% nominal shade. We used two variety of high bush blueberry pulan 9 & northland. Leaf size (width, length) were measured after when all leaves matured, internodes distance, leaf size, fruit yield, and harvest delay were recorded, In early September plant height, east and west crown, number of basal branches, and their height were assessed. We observed that internodes distance decrease with an increase of shade black 50% pulan 9 & black 70 % northland showed lowest record. Leaf size (width/length) increased with an increase of shade level, black 70% of both variety showed lowest record as compared to control. fruit yield decreased with an increase of shade level in both variety, black 70 % showed the lowest weight with 1.1kg of pulan 9 and 1.8kg northland as contrast to open treatment 3.7kg and 5.8kg. Shading high bush blueberry generally delays fruit harvesting time. this experiment showed green 50%,70% of pulan 9 was ready to pick up (3,7 days) after control treatment & northland green 50%,70%(4,8 days) .while black 30%,50%,70% of pulan 9 was ready to pick up (5,11,14 days) after control treatment other hand northland black 30%,50%,70% was (6,12,15 days).the result showed increase of shade level has negative impact on growth plant blueberry specially 50% and 70% .

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## Introduction

High bush blueberries are the most commonly cultivated blueberries in the world and are cultivated in the USA, Canada, Chile, Argentina, South Africa, Australia, New Zealand, Japan, China, and many parts of Europe (Strik, 2005; Strik and Yarborough, 2005). Furthermore, many of these growing areas are characterized by temperatures and solar radiation that are considerably higher than the natural surroundings of the species (Hancock and Siefker, 1982; Vander Kloet, 1988; Luby *et al.*, 1991; Hancock, 2006; Retamales and Hancock, 2012). Use of the photo-selective color shade nets to reduce radiation and temperature is a management system that is gaining popularity in a broad range of plants and could be helpful in reducing environmental hazards experienced by blueberries in farm fields of production. Research has been conducted to evaluate the reaction of ornamental plants (Schiappacasse *et al.*, 2007; Ovadia *et al.*, 2009; Saifuddin *et al.*, 2010), vegetables (Rylski and Spigelman, 1986a, b; Lopez *et al.*, 2007) and fruit crops (Stampar *et al.*, 2001; Shahak *et al.*, 2004; Cohen *et al.*, 2005; Jakopic *et al.*, 2007; Dufault and Ward, 2009) different variations of shade levels and net colors. Light is a key factor influencing the character of the leaf and the photosynthesis, controlling crop growth and development and determining the geographical distribution of the plant? Photosynthetic photon flux density (PPFD) is sometimes below the saturation level of photosynthesis due to canopy shade and weed shade, that often minimize crop growth and development (Soto-Pinto *et al.*, 2000; Zhang *et al.*, 2004; Stephan *et al.*, 2008). Shade nets are used cover crops to lower the heat stress (Elad *et al.*, 2007; Retamales *et al.*, 2008; Shahak *et al.*, 2004); furthermore, in closed net (shade) houses, daytime temperatures are usually higher than outside (Pe'rez *et al.*, 2006; Stamps, 1994) and might be lower at night, at least during radiation freezes (Stamps, 1994).

The aim of this research is to determine the effect of colored nets on high bush blueberry growth, fruit yield, and harvest time.

## Materials and methods

### *Overviews of test site*

Jingyu lies on the southern outskirts of the Changbai Mountains of Jilin, and the northern side of the town of Baishan on the upper slopes of Songhua River. Divisions at the east are Fusong County, South Jiangyuan, Western Huinan, and north Huadian. The neighboring county-level divisions include Fusong County. It'll take 42 degrees 06' to 42 degrees 48' N, and 126 degrees 30' to 127 degrees 16' E.

The county's height is 775 meters (2,543 ft) on average [1] but only 549.2 m (1,802 ft) on a county's side. Jingyu has a humid continental climate (Köppen Dwb) influenced by moon, with long, bitterly warm winters and short, but very dry, rainy summers. Spring and autumn, with some rain, are low. In January the 24-hour average monthly temperature is -17.4 ° C in July and 20.9 ° C in August, with a mean average annual temperature of + 3.38 ° C in 38.1 ° F. Situation on the mountain means that daily temperature changes in the winter are widespread, reaching 17 ° C (31 ° F), but there is an increase in precipitation, as the total precipitation is 764 mg with over 80% falling between May and September. This lasts only 104 days without frost.

### *Experimental design*

Experiment was started at the beginning of May 2019 two varieties of blueberry (pulan 9 and northland) were selected for experiment, and then selected 8 plants in each experiment and covered 7 different treatments, green 30%,50%.70 %, black 30%,50%70% and open. In both varieties.

Total plants of the experiment were 112 plants of combined varieties. The plants were irrigated regularly, pest was controlled and sufficient nutrients were supplied.

### *Vegetative parameters*

Leaf size (width, length) were measured after when all leaves matured, internodes distance was recorded, from 11 July till the first week of august were picking the fruit harvest delay and fruit yield of each

experiment was recorded. At the beginning of September was measured plant height, crown east and west, number basal branches and their height.

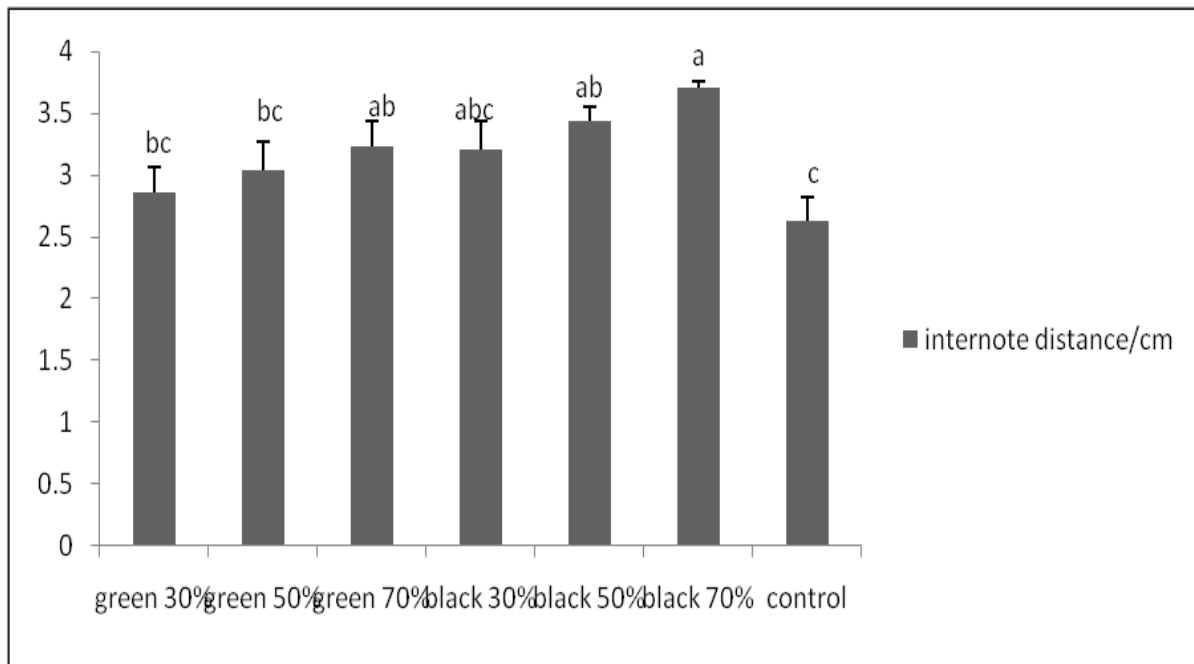
*Statistical analyses*

Statistical analyses was performed using (Statistix version 8.1) by using complete block design under factorial design.

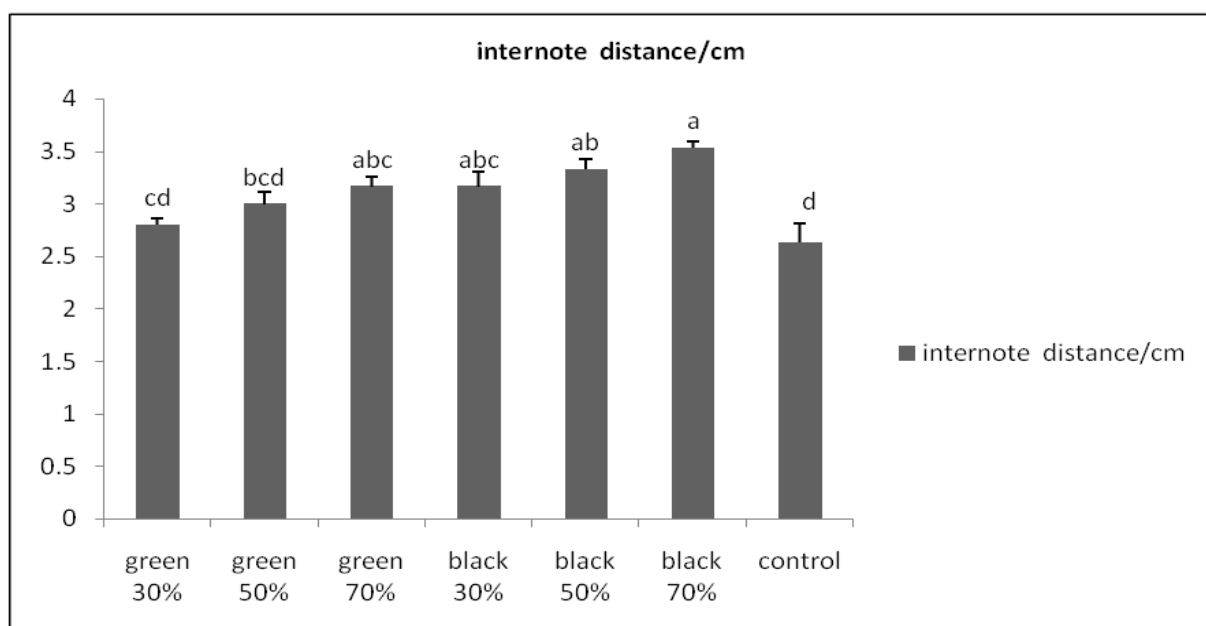
**Results**

*Internodes length*

In order to see the effects of shade nets we have collected data regularly from all varieties and we observed changes in internodes length .Internodes increased with increase of shade level. Black 70% recorded highest number of internodes while control treatment was lowest in both varieties (Figs 1, 2).



**Fig. 1.** Response of internodes length in (cm) of pulan 9 varieties high bush blueberry plant under shade nets of different levels.

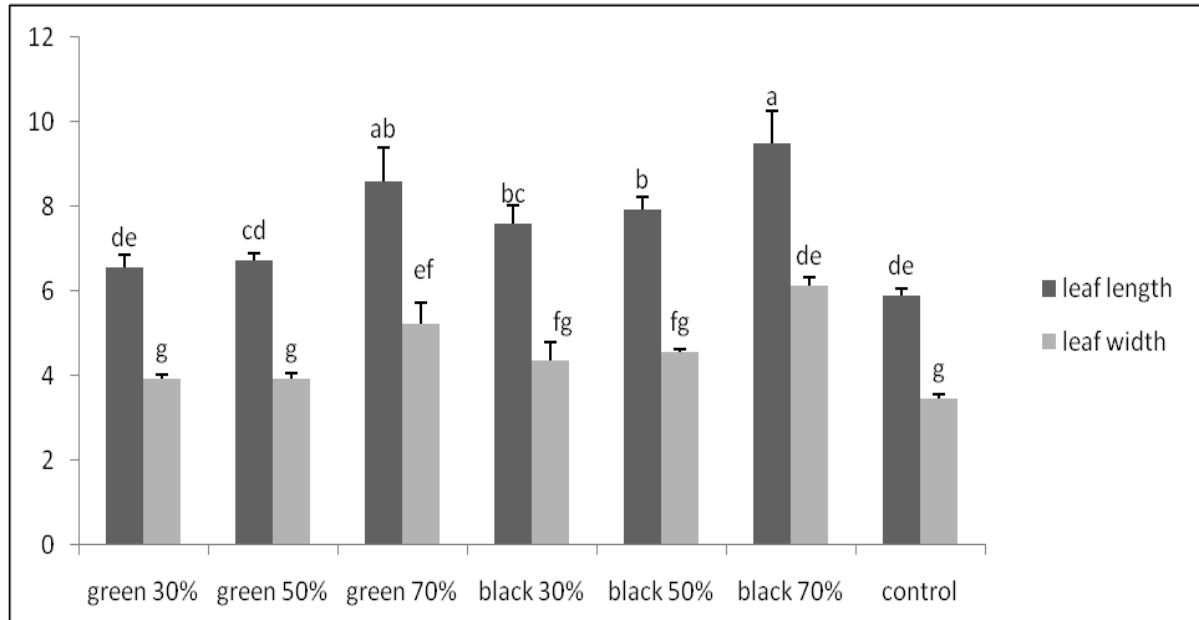


**Fig. 2.** Response of internodes length in (cm) of northland varieties high bush blueberry plant under shade nets of different levels.

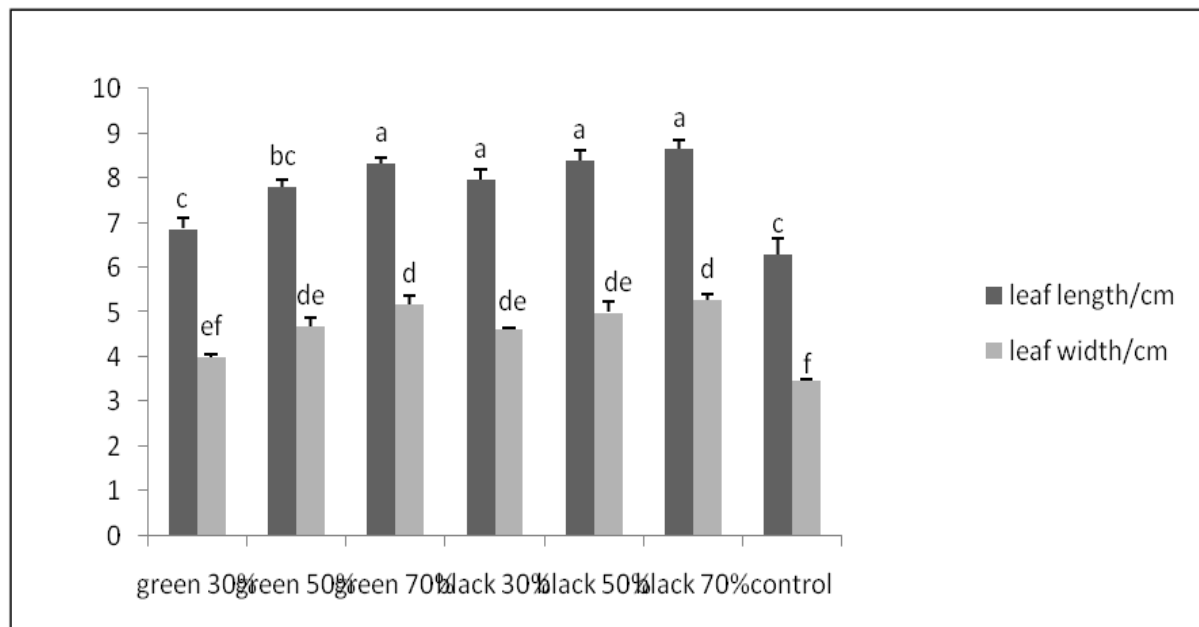
*Leaf size*

Leaf size (length and width) increased with increase of shade level (Figs 3, 4). Which results the following record green net 30%, 50%, 70%, and black net 30%, 50%, 70%. (5.9cm, 6.6cm, 6.73cm & 7.6cm, 7.9cm, 9.5) of leaf length and (3.4cm, 3.9cm, 3.93cm &

5.2cm, 4.5cm, 6.1cm) of leaf width of pulan 9 variety. Other side northland variety showed the following result green net 30%, 50%, 70% and black net 30%, 50%, 70%. (6.3cm, 6.8cm, 7.8cm & 7.9cm, 8.4cm, 8.6cm) of leaf length and (3.4cm, 4cm, 4.7cm & 5.1cm, 4.6cm, 5.2cm) of leaf width.



**Fig. 3.** Influence of different shade levels on leaf size of pulan 9 variety of high bush blueberry plant.



**Fig. 4.** Influence of different shade levels on leaf size of northland varieties of high bush blueberry plant.

*Fruit yield*

Fruit yield has been affected by shade level especially black nets which showed negative result in both varieties (Figs 5, 6). Green 30%, 50%, 70%, and black

30%, 50%, 70%. (3.8kg, 3.6kg, 3.3kg & 2.8kg, 1.66kg, 1.03kg) of fruit yield were for pulan 9 variety. Other side northland variety fruit yield record was green 30%, 50%, 70% and black 30%, 50%, 70% (

5.8kg,5.4kg,5.1kg,&3.6kg,2.3kg,1.8kg). Black net has showed negative impact of fruit yield in both varieties of experiment (fig.5, 6). Which badly affected the fruit yields of all experiments. Black 30% and black 70% of

pulan 9 and northland varieties showed the lowest record in all experiments as contrast to control treatment.

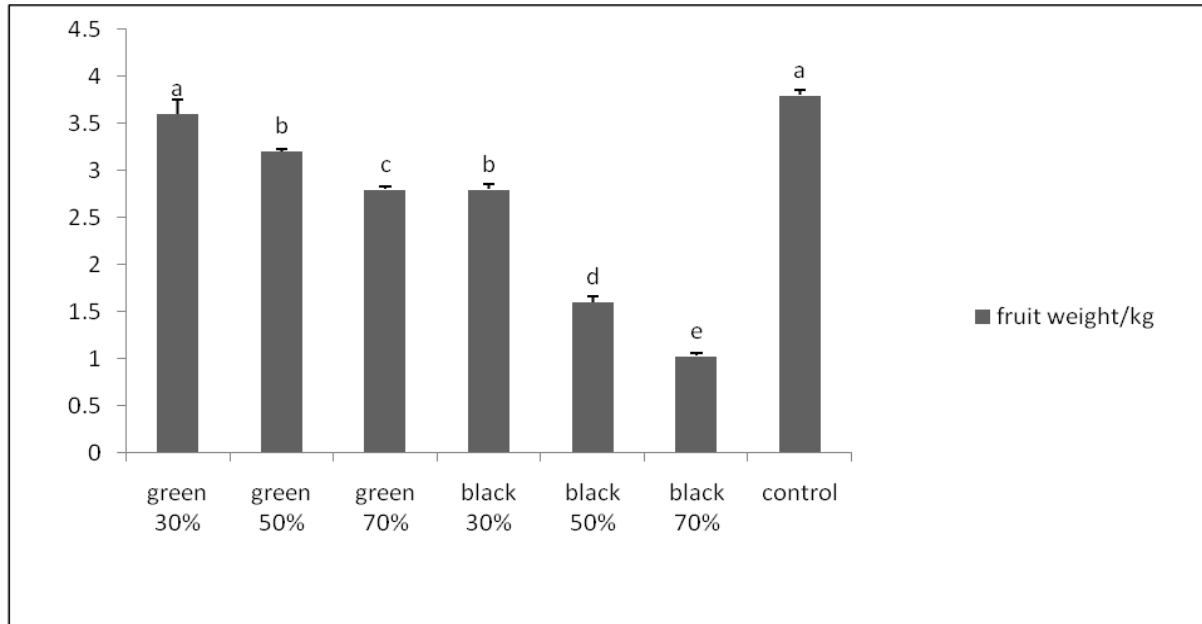


Fig. 5. Effect of shade nets in various shade level on fruit yield of pulan 9 varieties of high bush blueberry.

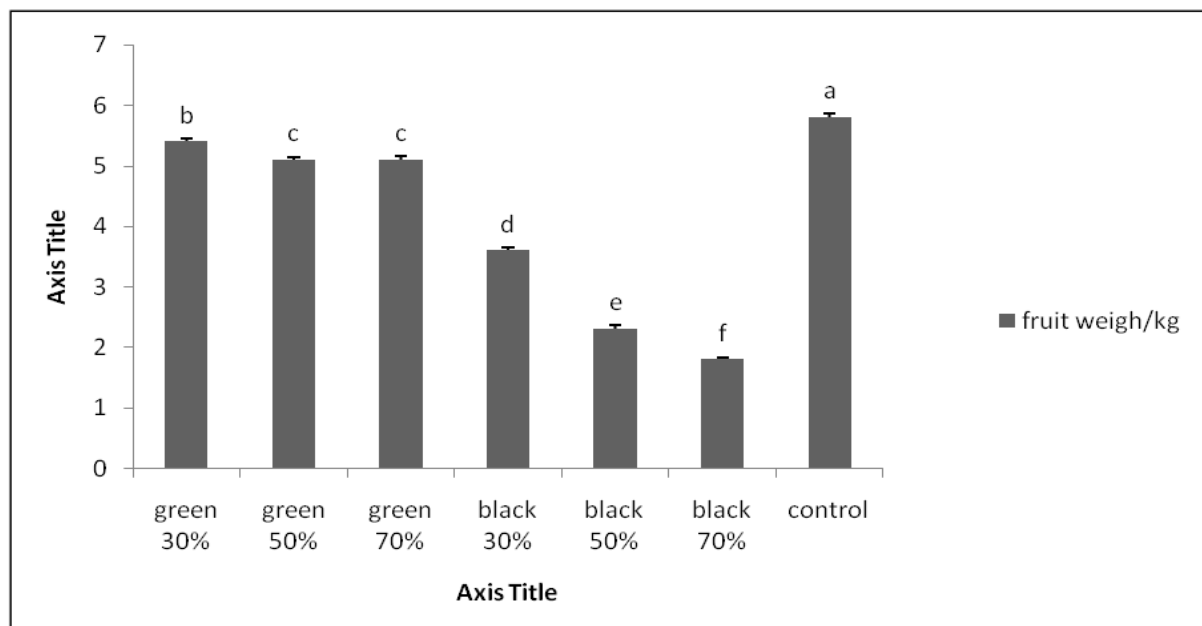


Fig. 6. Effect of shade nets in various shade level on fruit yield of northland varieties of high bush blueberry.

*Harvest delay*

Black nets mostly delay the fruit harvest (Figs7, 8). Which could lead economic loss to farmers. The consequence of harvest delay were green 30%, 50%, 70%, and black 30%, 50%, 70% (0,3,7 and 5,11,14 days, respectively) for pulan 9 variety. Other side

northland variety showed green 30%, 50%, 70% and black 30%,50%,70% (0,4 ,8 and 6,12,15 days, respectively).

*Plant height and other parameters*

Green 30% recorded highest of 111 cm of plant height

as compare to control treatment which was 105 cm of plant height, while black lowest record of 84cm of plant height in pulan 9(Fig.9). Other side northland green 30% recorded highest number of 121cm of height and black 70% was lowest at 99.3 cm of height

compared to control treatment which was 116cm (Fig.10). Green 70% recorded the lowest number of basal branches in pulan 9 and green 30% was highest. While northland green 70% was highest and green 30% was lowest (Figs 9, 10).

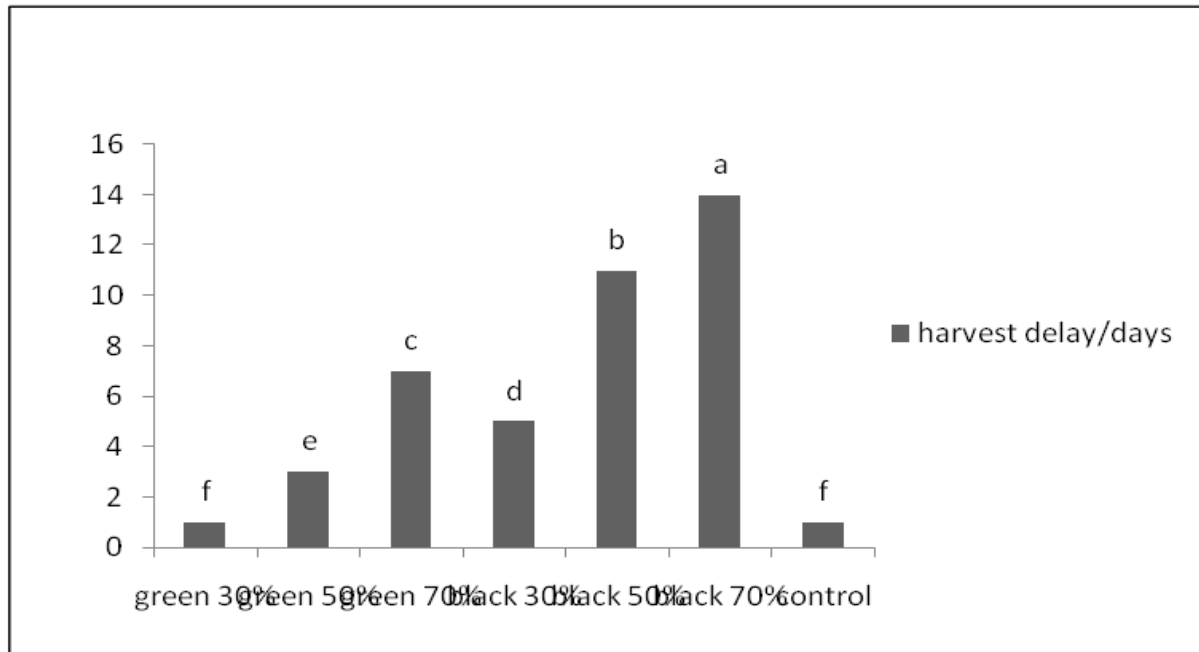


Fig. 7. Harvest delay of pulan 9 varieties of high bush blueberry under various shade level experiments.

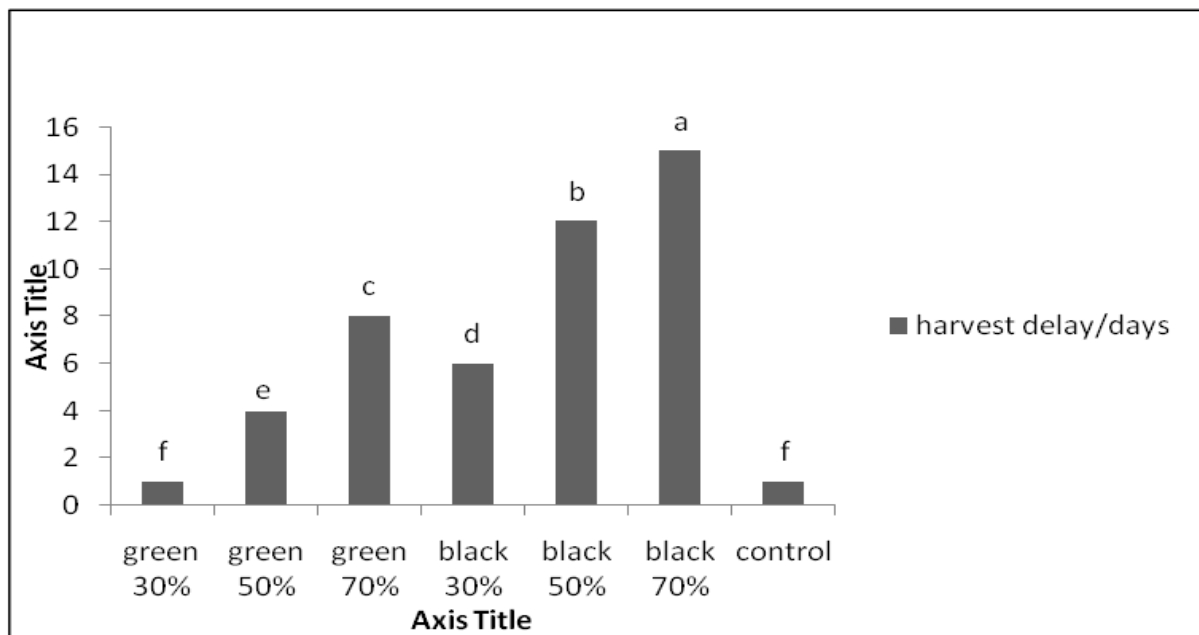


Fig. 8. Harvest delay of pulan 9 varieties of high bush blueberry under various shade level experiments.

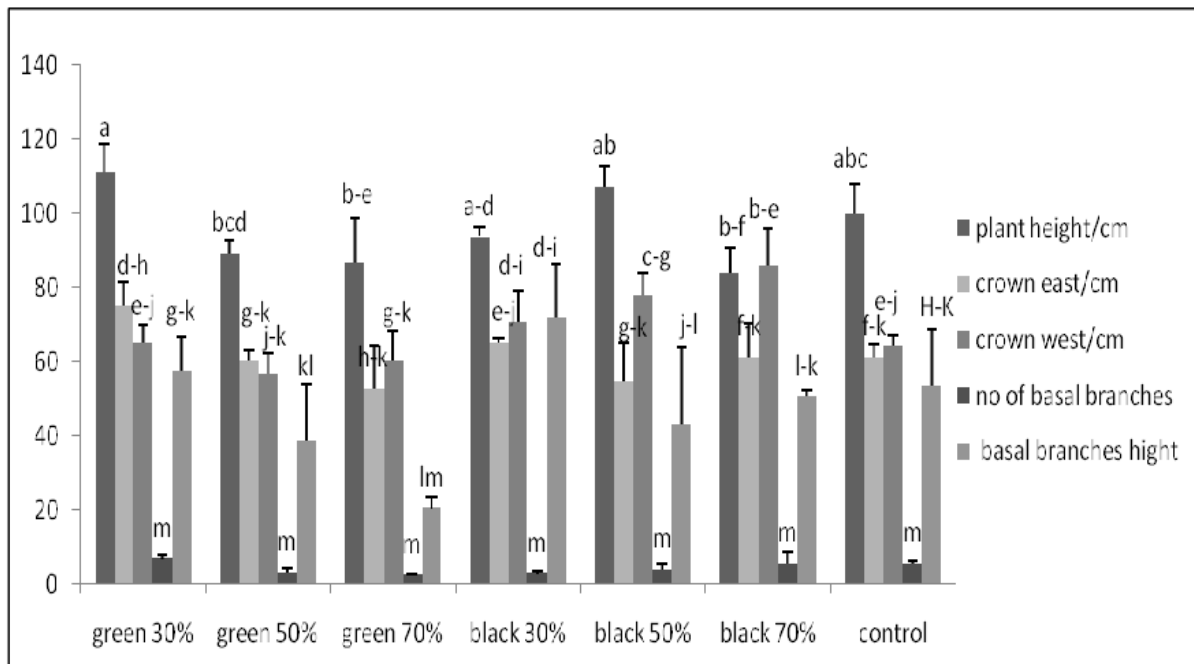
**Discussion**

Colored shade nets are a comparatively new instrument that can be used by horticulturists for a broad different purpose. But, the effects are diverse

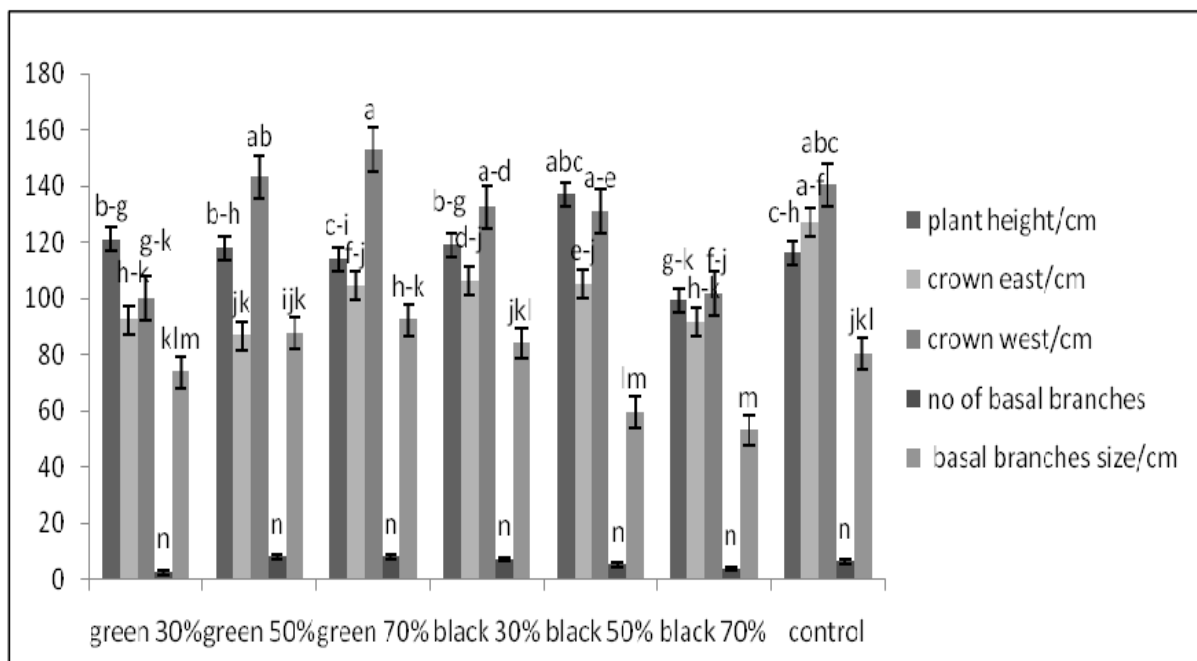
and the plant reactions may vary even between cultivars of a certain plant. Black shade net and green net treatments internodes distance increased with an increase of shade level in all treatments as compared

to control in both varieties. by (Retamales *et al.*, 2008)found similar result in red, white, gray and black (35%,50%) shade level on blueberry plant cv.berkeley in 2003-2004 season. Leaf length has increased with an increase of shade level in all experiments as compared to control. (Kim *et al.*, 2011) Reported same results on high bush blueberry.

Beraldi *et al.* (1994) found that black nets developed long shoots and leaves (length and width) in peaches. Black net, widely used by farmers, has long-term adverse effects on yield; it has reduced 12.5%, to, 69.1% as compared to control. (Retamales *et al.*, 2008). Also found on his reseatch he conducted in high bush blueberry cv. in Berkeley.



**Fig. 9.** Responses of plant height, crown east/west, number of basal branches/size of pulan 9 varieties of high bush blueberry under different shade levels.



**Fig. 10.** Responses of plant height, crown east/west, number of basal branches/size of northland varieties of high bush blueberry under different shade levels.

That black net yields first year were 37.2 and 8.3, while black net yields were 3.2 and 28%, respectively. A higher reconfiguration of carbohydrates into black nets would clarify their inability to produce higher yields.

In the days following fruit set in blueberries, shoots, roots, and leaves start competing for carbohydrates, water, and nitrogen (Darnell and Birkhold, 1996). In such situations, the production of fruit under shade treatment will increase the availability of water and increase the supply of carbohydrates from new leaves (Raveh *et al.*, 2003) This condition would enable these compounds to be more readily available to the fruit and it would increase the fruit set. Shade has a major effect on harvesting time whenever shade nets increase the harvest time increase.

The harvest delay in between (3-15 days) as compared to control. Lobos *et al.* (2013) reported harvest delay was highest at the minimal light level (20 percent) and reduced continuously with an increase of Photosynthetic active radion percent. Harvesting delays relative to controls were: three days under low shade, five to seven days under medium shade, and 7–13 days under high shade. Delay in harvesting under shading nets in peppers and peaches has been stated by Rylski and Spigelman, 1986b, a; Marini *et al.*, 1991.

### Conclusion

Shading with colored nets has created meaningful changes in reproductive behavior and several vegetative parameters of mature high-bush blueberries. Green and black shade nets increase internodes distance with an increase of shade level; they also affect the leaf size it increases with an increase of shade level. Furthermore, green 70% treatment reduced 25% of total fruit yield. In percentage of total yield of control Black 30%, 50%, 70% reduced 18.1%, 41%, 60.17% in pulan 9 as compare to total weight of control treatment. 12.5%, 38%, 61%, 69.1% in northland variety. Black shade net has a negative impact on plant growth it reduces fruit yields and delays the fruit harvest up to 7 to 16

days which could lead to economic loss to farmers. We recommend to farmers not use black net shade frequent, especially 50% and 70% shade.

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