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Original Article

Physiological Growth and Yield of Two Groundnut Varieties as Influenced by Light and Boron

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Abstract

Light and boron play a significant role in the physiological growth and yield of crops such as groundnut. Even so, there has been little information on the application of boron in groundnut, while no information is available in Bangladesh regarding the imposition of light in groundnut. Therefore, two field experiments were conducted in order to evaluate the physiological growth and seed yield of groundnut. Treatments included two levels of light, *viz*., L_0 = normal day length (≈12-h light) and L = normal day length + 6-h extended light at night (≈18-h light); three levels of boron, *viz*., 0-kg B ha^{-1} (B_0), 1-kg B ha-^{1} (B_1) and 2-kg B ha^{-1} (B_2), and two groundnut varieties, *viz*., V_1 = 'Dhaka-1' and V_2 = 'BARI Chinabadam-8'. The results obtained from the experiment revealed that the highest LAI, LAR, LMR and RWR were recorded in L, B_2 and V_2 variants, while NAR was the highest in L_0 and B_0. Moreover, it was noted an inconsistent result for RGR found for boron application. Based on the results, it could be concluded that boron is one of the factors responsible for higher yield of groundnut; nevertheless, under the extended light, it is not possible to get the highest yield.

Keywords: boron, light, micronutrient, yield, groundnut, physiological growth, peanut

Introduction

Groundnut (*Arachis hypogaea* L.) is one of the major and crucial oilseed crop, as well as protein rich crop, in the world (Onemli, 2012), while boron is an important micronutrient that is essential for healthy growth and development of groundnut (Gascho and Davis, 1995). This micronutrient played a vital role in the different physiological functions and process of plants (Mengel and Kirkby, 1982). As a result, application of boron facilitated the vegetative growth and reproductive development of groundnut. A slight quantity of boron is required by plants (El-Wahab and Mohamed, 2008) but the application of this element in crops was limited in farmer's field (Nasreen *et al*., 2015). As a result, this nutrient was rapidly becoming deficient in soils (Tahir *et al*., 2009) and the boron deficiency problem had been identified in Bangladesh (Ahmed and Hossain, 1997). Therefore, more research was needed to find out the effect of the application of boron in the soil of Bangladesh. So, it was a principal issue to investigate the response of boron on physiological growth as well as the yield of groundnut.

Light also solely played a crucial role in the physiological process and reproductive development of legume crops, like groundnut. The three most important characteristics of light (quantity, quality and direction) were perceived by different photosensory systems of the plant that collectively regulate the plant development (Hangarter, 1997). Imposition of light positively influenced on the vegetative growth, but reduced the yield of groundnut (Nigam *et al*., 1998; Bagnall and King, 1991; Quamruzzaman *et al*., 2016a). It was noted with specific evidence that excessive light stress can lead to antioxidant enzymes activation as well as ROS (Reactive Oxygen Species) accumulation in the plant (Mittler, 2002).

Never the less, no light experiment was conducted in Bangladesh to evaluate the effect of artificial light on physiological growth as well as yield of groundnut. As for why the present study was carried out, in order to determine the exact duration of light and the optimum boron levels for an improved physiological growth and yield of groundnut.

Materials and Methods

Experimental site

Two trial experiments were conducted at the Central Experimental Farm, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh. The first trial duration was between 17th March to 10th July 2014 and the second trial

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duration was between 15th March until 08th July 2015, respectively. Both experiments were conducted in the same field and soil samples of the experimental field werew analyzed in the laboratory of Soil Resource Development Institute (SRDI) before the experiment set up (Table 1). The experimental field was located at the Madhupur Tract, which is the name of the Agro-ecological Zone "AEZ-28" (BBS 2014-15). The average air temperature, relative humidity and rainfall of the two cropping seasons (2014 & 2015 cropping season) of the experimental site were also recorded (Table 2).

Field operations

Cultivars 'Dhaka-1' (Maizchor Badam) and 'BARI Chinabadam-8' were used for the experiment. Seeds were provided by BARI (Bangladesh Agricultural Research Institute), Gazipur. Along with boron (source: Boric Acid), the recommended doses of organic and inorganic fertilizer were incorporated with soil during final land preparation. Cowdung, urea, triple superphosphate, muriate of potash, gypsum and zinc sulphate were applied at 10 t ha^{-1}, 25 kg ha^{-1}, 160 kg ha^{-1}, 75 kg ha^{-1}, 170 kg ha^{-1} and 4 kg ha^{-1}, respectively.

Experimental design and treatment details

Both of the experiments were laid out in a 2×3×2 factorial design with three replications. Spacing was maintained 30 cm x 15 cm and seed rate was of 110 kg seeds ha^{-1}(with shell). The first factor was duration of light, e.g., normal day length + 6^{-h} extended light at night (≈18-h light) (L) and normal day length (≈12-h light) (L_0); the second factor was represented by the three levels of boron (source: Boric Acid) viz., 0 kg B ha^{-1} (B0), 1 kg B ha^{-1} (B_1) and 2 kg B ha^{-1} (B_2); the third factor was represented by two groundnut varieties viz., 'Dhaka-1' (V1) and 'BARI Chinabadam-8' (V2). The artificial lightening was done by fluorescence bulb to ensure the extended day length. This lightening was started after seedling emergence (one month after seed sowing) from 18:00 h 24:00 h at 30-50,000 lux.

Table 1. Composition of soil elements of the experimental field

Element	Levels in the soil plot
pH	5.9
N	0.071%
K	0.31 meq/100 g soil
Ca	6.36 meq/100 g soil
P	14.04 µg/g soil
S	15.16 µg/g soil
B	0.30 µg/g soil
Sand	27%
Silt	43%
Clay	30%
Organic matter	0.78%

N=Total nitrogen, K=Exchangeable potassium, Ca= Exchangeable calcium, P= Exchangeable Phosphorous, S=Exchangeable Sulphur, B=Available boron

Data collection

Data were collected on physiological parameters viz., leaf area index (LAI), leaf area ratio (LAR), leaf mass ratio (LMR), root weight ratio (RWR), relative growth rate (RGR), net assimilation rate (NAR) and yield contributing characters viz., seed yield and harvest index (HI). The parameters were measured as described below:

$$LAI = LA/GA$$

Where, LAI = leaf area index, LA = Leaf area (cm^2), GA = ground area (cm^2)

$$LAR = LA/PDW$$

Where, LAR = leaf area ratio, LA = Leaf area (cm^2), PDW = plant dry weight (g).

$$LMR = LDW/PDW$$

Where, LMR = leaf mass ratio, LDW = leaf dry weight (g).

$$RWR = RDW/PDW$$

Where, RWR = root weight ratio, RDW = root dry weight (g).

$$RGR = (\ln PDW\_2 - \ln PDW\_2)/((t\_2 - t\_1))$$

Where, t = time. Subscripts 1 and 2 refer to the initial and sampling dates (days), respectively.

$$NAR = RGR/LAR$$

$$HI = (\text{Economic yield})/(\text{Biological yield})$$

Where Economic yield (pod yield) biological yield were measured as t ha-1

Statistical analysis

Data collected in two cropping seasons (2014 and 2015) were mean together on account of the non-significant interaction. Then one-way ANOVA (analysis of variance) of means data of two trial experiments was analyzed by using IBM SPSS (Version 20.0) and mean separation was done at P ≤ 0.05 by using Tukey's test (Tukey, 1977).

Results and Discussion

Leaf area index (LAI)

Leaf area index varied significantly by different light treatment (Table 3). Results revealed that LAI increased in L compared to L_0. Data showed that the LAI ranged from 6.13 (L_0) to 9.41 (L_l). Higher LAI is one of the most important criteria that help to produce higher metabolites of plants. Increased LAI has been found to increase the capability of the plants to intercept more light (Prieto *et al.*,

Table 2. Monthly record of air temperature, relative humidity and rainfall of the experimental site during the period of March to July 2014 and 2015 (Mean of two years)

Month	Air temperature (°C)		Relative humidity (%)		Rainfall (mm) (total)
	Maximum	Minimum	Maximum	Minimum	
March	37.4	20.2	80.2	32.4	3.80
April	39.4	19.4	80.2	39.2	65.60
May	38.2	19.3	89.2	40	202
June	37.2	17.4	88.4	46.3	282.7
July	35.6	18.2	88.2	55.4	107.8

Source: Sher-e-Bangla Agricultural University mini weather station, Dhaka-1207, Bangladesh

2007). The highest LAI was found due to the supplementation of L that may have the ability to produce higher metabolites in groundnut.

Leaf area index was increased significantly up to 90 DAP and then decreased at harvest in boron application area (Table 3). Due to different doses of boron, the variation of LAI was observed, and it ranged from 0.64 (B_0) to 10.74 (B_2). Probably, application of boron increased the vegetative growth of plant up to the certain period and then started to work on the reproductive unit. It had evidence that the application of boron increased the vegetative growth and yield of groundnut (Singaravel *et al.*, 2006; Kabir *et al.*, 2013), which is in consequence of the increased LAI and the resultant increased light interception (Prieto *et al.*, 2007). The higher LAI was found due to the application of B2 that may have the ability to produce higher metabolites in groundnut. Geethanjali *et al.* (2015) stated that application of boron increased the leaf area and LAI of groundnut.

Leaf area ratio (LAR)

Table 3 showed that the highest leaf area ratio was recorded from L_0 at 60 DAP (276.97 cm^2 g^{-1}) and 90 DAP (139.98 cm^2 g^{-1}), but at harvest the highest LAR was found from L (82.29 cm^2 g^{-1}). Variation in LAR due to the imposition of light produced the highest leaf area and plant dry weight compared with control at 60 DAP and 90 DAP. It was observed that leaf shedding started after 90 DAP and got the maximum at harvest in L treatment area. Probably this leaf shedding was responsible for the highest LAR in light treatment plots. Therefore, it can be concluded that the supplementation of light facilitated vegetative growth (Ketring, 1979), as given by the results with the highest leaf area and plant dry weight as well as LAR.

Due to the application of boron, the highest LAR was recorded from boron at 1-kg ha^{-1} at all sampling dates and the lowest were from control treatment (Table 3). Data also represented that LAR is showing an increasing trend up to 60 DAP and then started to gradual decrease up to the harvest, because boron was responsible for the vegetative growth of groundnut plant (Kabir, 2013). Harris and Brolmann (1996) also reported that plant dry weight increased with the application of boron in groundnut. The addition of B was also responsible for the leaf expansion of groundnut (Dell and Huang, 1997). Thus, a higher value of LAR was found in boron application area.

Leaf mass ratio (LMR)

For the supplementation of additional light, the leaf mass ratio showed variation result at all sampling dates (Table 4). The highest LMR was recorded as 0.875 g g^{-1} and the lowest as 0.280 g g^{-1}. Though, the light was responsible for the highest plant dry weight (Ketring, 1979) and leaf dry weight (Acock *et al.*, 1996), it did not produce the highest LMR at 60 DAP. Data showed that light treatment produced maximum LMR at 90 DAP and at harvest. Probably, at 60 DAP plants did not get enough light to produce high LMR, where as in the present study light was imposed just after 30 DAP.

Boron at 2 kg ha^{-1} produced significantly ($p \leq 0.001$) higher LMR at all growth stage (Table 4) where the lowest LMR was found from control treatment. The highest number of leaf, plant dry weight and leaf dry weight, as well as LMR, were recorded from boron at 2-kg ha^{-1}. It was reported that vegetative growth, as well as plant dry weight of groundnut, were the highest for application of boron (Kabir *et al.*, 2013). So, the fact that LMR was significantly higher for the application of boron. Prieto *et al.* (2007) stated that increased LMR gave a higher capability of the plants to intercept more light. The highest LMR was found due to the application of B_2 that may have the highest capability to produce more elevated metabolites in groundnut.

Root weight ratio (RWR)

Root weight ratio differed significantly due to the imposition of light (Table 4). The highest RWR was found at harvest in L (0.080 g g^{-1}) and the lowest at 90 DAP in L0 (0.045 g g^{-1}). The RWR showed a decreasing trend up to 90 DAP, but at harvest it suddenly increased for both treatments. This might be due to leaf shedding, since leaf shedding started after 90 DAP and it was maximum at

Table 3. Effect of light and boron on leaf area index and leaf area ratio of two groundnut varieties (mean of two trails)

Treatment	LAI				LAR (cm^2 g^{-1})			
	30 DAP	60 DAP	90 DAP	Harvest	30 DAP	60 DAP	90 DAP	Harvest
				Light (L)				
L	-	6.39	9.41	8.24	-	212.88	135.76	82.29
L_0	-	6.13	8.78	6.91	-	276.97	139.98	74.85
				Boron (B)				
B_0	0.64	5.06	6.19	6.55	162.922	216.513	160.705	70.927
B_1	1.06	6.65	10.37	7.98	230.382	267.873	155.804	84.358
B_2	1.11	7.08	10.74	8.29	200.471	250.384	151.092	80.426
				Variety (V)				
V_1	0.824	5.08	7.32	7.01	221.001	240.351	117.025	90.024
V_2	1.051	7.44	10.87	8.14	174.849	249.025	158.709	67.116
				Significance (*P*) at 5%				
L	-	0.002	<0.001	<0.001	--	<0.001	0.007	<0.001
B	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
V	<0.001	<0.001	<0.001	<0.001	<0.001	0.054	<0.001	<0.001
L×B	-	0.002	0.148	0.931	-	0.094	0.045	0.238
L×V	-	0.169	<0.001	0.338	-	0.019	0.005	0.016
B×V	<0.001	<0.001	<0.001	<0.001	0.064	<0.001	0.077	<0.001
L×B×V	-	0.009	<0.001	0.308	-	0.001	<0.001	0.747

DAP= Day After Planting, B= Boron; L= light; V= Variety; P= Probability. Means were separated by Tukey's test at P ≤ 0.05, B_0= 0 Kg B ha^{-1}(Control), B_1= 1 Kg B ha^{-1}, B_2= 2 Kg B ha^{-1}, L= normal day light + 6-h extended light at night (≈18-h light), L_0= normal day light (≈12-h light), V_1= 'Dhaka-1', V_2= 'BARI Chinabadam-8' harvest. Even so, root dry weight was almost the same as 90 DAP data. The longer roots, as well as the highest root weight, might be responsible for the highest nutrient uptake from soil. And the highest RWR could be responsible for the highest vegetative growth of plants, as concluded by Nigam *et al*., 1994, who noted that light facilitated the highest vegetative growth in peanut plants.

Root weight ratio was significant in boron application area (Table 4). The highest significant RWR was recorded from 2-kg boron ha^{-1} at all sampling dates (0.198 g g^{-1}, 0.089 g g^{-1}, 0.063 g g^{-1} and 0.083 g g^{-1}, respectively). Harris and Brolman (1966) stated that due to the application of boron root weight increased and Kabir *et al*. (2013) found that groundnut plants' dry weight was highest for boron fertilization. Therefore, RWR in the present study might also be the highest for the application of boron.

Relative growth rate (RGR)

The relative growth rate was the highest at 60 DAP in L, but the rest of sampling dates it was highest in L_0 (5). Due to the light treatment, the significantly decline trend of RGR towards physiological maturity could be a result of leaf shedding. There is also evidence that the upper leaves when in dense condition caused shedding effect on the lower leaves reducing the photosynthetic capability and imposing them to more pest attack (Banik *et al*., 2009).

Boron produced inconsistent, but significant, relative growth rate at all growth stage (Table 5). The highest plant dry weight was found from boron at 2-kg ha^{-1}, but in the case of RGR it was not consistent among the boron treatments, because initial plants dry weight was not similar for different treatments. Cikili *et al*. (2015) found that application of boron increased plant growth and biomass production up to a certain growth stage, but when more boron doses were applied soil toxicity occurred, that reduced plant growth and biomass production. In the current study, it was not observed boron toxicity effect. Since plant dry weight was significantly higher for the addition of boron, RGR also might be significant for boron application. RGR was not showing the similar trend as others parameter studied hereby, as why further study is continuing to find out the inconsistent result of RGR.

Net assimilation rate (NAR)

Net assimilation rate was found with a significantly increasing trend up to 90 DAP due to light treatment (Table 5). The highest NAR was recorded from light treatment compared with control treatment, at 60 DAP and 90 DAP, but at harvest, it showed a decreasing trend. The decreased trends of net assimilation rate in groundnut may be due to mutual shading at physiological maturity stage of plants, which affects the lower leaves and thus reduce the photosynthetic capability of the older leaves (Banik *et al*., 2009). This mutual shading is also responsible for pest attack that reduced leaf area of groundnut (*Banik et al*., 2009). Data revealed that light helped to produce the highest vegetative unit in a plant that was most relevant to higher NAR. Quamruzzaman *et al*. (2016a) reported that light helped to produce the highest vegetative growth, thus the current data consisted with their finding.

Although at 30 DAP the highest NAR was recorded from 2-kg ha^{-1} boron application area, at the rest of sampling dates control treatment produced the highest NAR (Table 5). It had evidence that shading reduced the NAR, but had

Table 4. Effect of light and boron on leaf mass ratio and root weight ratio of two groundnut varieties (Mean of two trails)

Treatment	LMR (g g^{-1})				RWR (g g^{-1})			
	30 DAP	60 DAP	90 DAP	Harvest	30 DAP	60 DAP	90 DAP	Harvest
				Light (L)				
L	-	0.759	0.472	0.331	-	0.074	0.059	0.080
L_0	-	0.875	0.445	0.280	-	0.067	0.045	0.063
				Boron (B)				
B_0	1.703	0.757	0.366	0.275	0.161	0.053	0.043	0.060
B_1	2.019	0.810	0.457	0.308	0.168	0.069	0.049	0.075
B_2	2.507	0.885	0.557	0.333	0.198	0.089	0.063	0.083
				Variety (V)				
V_1	2.410	0.881	0.402	0.344	0.179	0.075	0.0524	0.080
V_2	1.743	0.752	0.515	0.266	0.172	0.065	0.0519	0.063
				Significance (P) at 5%				
L	-	<0.001	<0.001	<0.001	-	0.030	<0.001	<0.001
B	<0.001	<0.001	<0.001	<0.001	0.012	<0.001	<0.001	<0.001
V	<0.001	<0.001	<0.001	<0.001	0.447	0.003	0.967	<0.001
L×B	-	0.308	<0.001	0.634	-	0.494	0.036	0.969
L×V	-	0.002	<0.001	0.054	-	0.709	0.001	0.218
B×V	0.790	0.827	<0.001	<0.001	0.098	0.835	0.030	0.004
L×B×V	-	0.001	0.700	0.008	-	0.416	0.416	0548

DAP= Day After Planting, B= Boron; L= light; V= Variety; P= Probability. Means were separated by Tukey's test at $P \leq 0.05$, B_0= 0 Kg B ha^{-1}(Control), B_1= 1 Kg B ha^{-1}, B_2= 2 Kg B ha^{-1}, L= normal day light + 6-h extended light at night (≈18-h light), L_0= normal day light (≈12-h light), V_1= 'Dhaka-1', V_2= 'BARI Chinabadam-8'

Table 5. Effect of light and boron on relative growth rate and net assimilation rate of two groundnut varieties (mean of two trails)

Treatment	RGR (g g^{-1} d^{-1})				NAR (g cm^{-2} d^{-1})			
	30 DAP	60 DAP	90 DAP	Harvest	30 DAP	60 DAP	90 DAP	Harvest
				Light (L)				
L	-	0.099	0.035	0.006	-	0.000470	0.000278	0.000092
L_0	-	0.094	0.042	0.007	-	0.000347	0.000319	0.000103
				Boron (B)				
B_0	0.020	0.098	0.038	0.008	0.000143	0.000469	0.000374	0.000116
B_1	0.024	0.097	0.039	0.005	0.000110	0.000372	0.000262	0.000080
B_2	0.031	0.094	0.038	0.006	0.000168	0.000384	0.000260	0.000096
				Variety (V)				
V_1	0.017	0.098	0.043	0.001	0.000083	0.000423	0.000379	0.000007
V_2	0.033	0.094	0.034	0.013	0.000198	0.000394	0.000218	0.000188

Significance (*P*) at 5%								
L	-	0.001	<0.001	0.737	-	<0.001	<0.001	0.003
B	<0.001	0.016	<0.001	<0.001	0.002	<0.001	<0.001	<0.001
V	<0.001	0.006	<0.001	<0.001	<0.001	0.004	<0.001	<0.001
L×B	-	0.283	0.002	<0.001	-	0.001	0.734	<0.001
L×V	-	0.011	0.039	<0.001	-	0.002	1.000	<0.001
B×V	0.462	0.423	<0.001	0.202	0.096	0.005	<0.001	0.121
L×B×V	-	0.487	0.011	0.292	-	0.027	0.001	0.392

DAP= Day After Planting, B= Boron; L= light; V= Variety; P= Probability. Means were separated by Tukey's test at P ≤ 0.05, B_0= 0 Kg B ha^{-1}(Control), B_1= 1 Kg B ha^{-1}, B_2= 2 Kg B ha^{-1}, L= normal day light + 6-h extended light at night (≈18-h light), L_0= normal day light (≈12-h light), V_1= 'Dhaka-1', V_2= 'BARI Chinabadam-8'

no effect on yield (Watson and Wilson, 1956) and the highest number of leaves was observed from boron at 2-kg ha^{-1}. The highest leaf area was found from B2 that might be created excessive shading and maximum numbers of new leaves could have the highest shading effect on older leaves. Thus, NAR decreased due to the application of boron, but B probably helped to increase the uptake of nutrients, that ultimately resulted in the highest yield of groundnut (Naikanware *et al.*, 2015). NAR was not showing the similar trend like other parameters investigated, as why further study is continuing to find out the inconsistent result of NAR.

Seed yield (t ha^{-1})

Light treatment was responsible for the significant (p≤0.001) reduction of seed yield. Data showed that the highest significant seed yield was recorded from control treatment (L_0=1.37 t ha^{-1}) compared than additional light (L=1.23 t ha^{-1}) (Fig. 1). So, the 6-hr extended light might be responsible only for vegetative growth and dry matter produced. Probably this limited time light duration was not responsible for better seed yield. Quamruzzaman *et al.* (2016b) also stated that the low yield of groundnut was found due to the extended light.

Boron was highly responsible for better yield of groundnut and a significant positive seed yield was recorded from application of boron (Fig. 1). The highest groundnut seed yield (1.53 t ha^{-1}) was found from boron at 2-kg ha^{-1} and the lowest from control. Because boron was highly responsible for the reproductive development of groundnut (Ansari *et al.*, 2013) and highest yield was recorded in boron treatment area. The finding of Naiknaware *et al.* (2015) also supported the present finding.

Harvest index (HI)

Harvest index was significantly influenced by the light treatment. The additional artificial light was sensible for better vegetative growth. As for why supplementation of light produced the lowest HI (31.75) compared to control (37.457) (Fig. 2). The highest economic yield was found in L_0 and the highest biological yield in L. Probably the extended photoperiod limited the reproductive development of groundnut, but increased the vegetative growth (Ketring, 1979). Quamruzzaman *et al.* (2016a) also reported similar findings.

Boron treatment also caused a significant increasing result of HI. The highest HI (38.323) was significantly observed from boron at 2-kg ha^{-1} compared to other treatments (Fig. 2), but control and 1-kg boron ha-1 showed statistically similar results. The reason behind these findings might be that the number of pods and pod dry weight increased after the application of boron. Literature revealed that the reproductive development of groundnut can be influenced by boron, which significantly produced higher seed yield in groundnut (Jena *et al.*, 2009), whereas

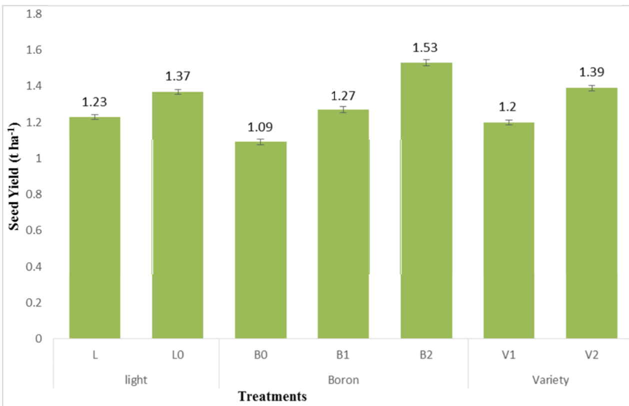

Fig. 1. Effect of boron and light on seed yield (t ha^{-1}) of two groundnut varieties

B= Boron; L=Light; V= Variety; B_0= 0 kg B ha^{-1}, B_1= 1 kg B ha^{-1}, B_2= 2 kg B ha^{-1}, L= normal day light + 6-h extended red light at night (≈18-h light), L_0= normal day light (≈12-h light), V_1='Dhaka-1', V_2= 'BARI Chinabadam-8'. Means were separated by Tukey's test at P ≤ 0.05. Vertical bars represent the standard error of the means.

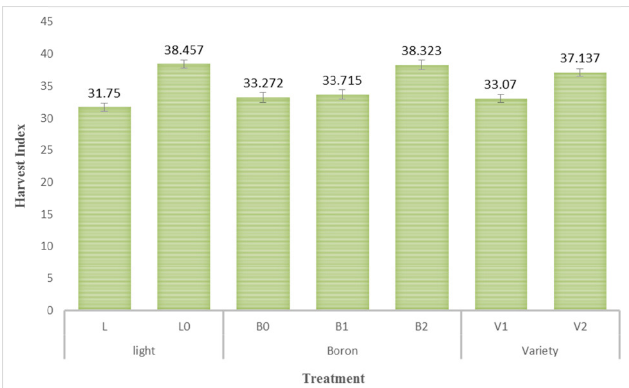

Fig. 2. Effect of boron and light on harvest index of two groundnut varieties

B= Boron; L=Light; V= Variety; B_0= 0 kg B ha^{-1}, B_1= 1 kg B ha^{-1}, B_2= 2 kg B ha^{-1}, L= normal day light + 6-h extended red light at night (≈18-h light), L_0= normal day light (≈12-h light), V_1='Dhaka-1', V_2= 'BARI Chinabadam-8'. Means were separated by Tukey's test at P ≤ 0.05. Vertical bars represent the standard error of the means.

harvest index might be higher in boron application area.

Therefore, light and born have a special importance on the vegetative growth and yield of groundnut, whereas both of the factors were highly responsible for the highest result of LAI, LAR, LMR and RWR. But in the case of RGR and NAR, an inconsistent result was found between the boron and light treatment.

Conclusions

In conclusion, boron application in groundnut field had a significantly positive impact that helped to produce higher physiological growth and yield of groundnut. But, due to the imposition of artificial light, it had both positive and negative effect on the physiological growth, whereas light reduced the seed yield. Thus, it is recommended to use boron, but not impose light, to get a better yield of groundnut. Boron helped to increase the physiological growth, pollen grain viability and stigma receptivity. That ultimately increased the number of pods, as well as pod yield. Supplementation of light increased the physiological growth and the number of flowers of groundnut. Therefore, light could increase the pod yield, but the duration of light was not enough for partitioning of dry matter towards the reproductive unit.

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