

## Effect of Photoperiod on the Growth and Bulbing of Tropical Onion (*Allium cepa* L) Varieties

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**Abstract:** Onion varieties are generally classified by day-length and it is believed that only plants adapted to regions far away from the equator respond distinctly to photoperiods. This study was set up to investigate the effects of five photoperiods on the vegetative growth and bulbing of two tropical onion varieties. The plants were exposed to photoperiods of 8, 10, 12, 14 and 16 h in 2000 growing season and photoperiods of 8, 11, 12, 13 and 18 h in 2002 growing season to ascertain the vulnerable and supportive day length for optimal growth and bulbing of the two tropical onion varieties. The results obtained indicated that photoperiods below 11 h suppressed bulbing in the two varieties studied. Bulbing was increased progressively with increasing in day-length. With respect to the plants' leaf lengths, it was observed that leaf length was directly proportional to increase in day-length. However, it was observed also that plant heights and number of leaves per plant were not directly proportional to increase in photoperiod. The most important data obtained in this study was that there were no bulbing at photoperiods below 11 h; but bulbing thereafter increased progressively with increase in day length.

**Key words:** Tropical • *Allium cepa* • photoperiod • day-length • bulbing

### INTRODUCTION

Onions are biennial monocots that are cultivated as annuals, a cool-season crop requiring temperatures of at least 55 degrees Fahrenheit to emerge from seed. Optimum leaf growth rates occur at temperatures of 68 degrees Fahrenheit to 77 degrees F. High quality onions require cool temperatures during early development and warmer temperatures during maturity [1]. Onion varieties are generally classified by day-length (short, intermediate and long). Short day onion variety implies that the plant grows, flowers and bulbs satisfactorily in less than 12 h of photoperiods. According to [1-3], generally, short day-length onions are suitable for warm climates, hence, tropical onion varieties are classed short day plants.

That, any plant of a given critical photoperiod less than 12 h is short day plants and only plants adapted to regions far away from the equator respond distinctly to photoperiods is a misconception. Katherine Adam [4] established that tropical plants do respond to short day variations in day-length; also Uzo and Currah [5] working with local varieties of onion found that under short day conditions, the onion plant tends to produce new leaves indefinitely without bulb formation while at longer day

lengths bulbs were formed, showing that critical day-length for bulb initiation and bulb development do exist under natural conditions,

There is sufficient information on temperate onion varieties with respect to climatic factors including day-length. But there is paucity of information on the characteristics, production and nature of photoperiodic response to tropical onion cultivars [6]. This research, therefore, is intended to find the effect of various long and short photoperiods on the growth and bulbing of tropical onions.

### MATERIALS AND METHODS

Two experiments were conducted in the Teaching and Research Farm of the Faculty of Agriculture, University of Nigeria, Nsukka, during the 2000 and 2002 growing seasons. In both experiments, the experimental design was a Completely Randomized Design (CRD) with four replications.

In the first experiment, the treatments were 8, 10, 12, 14 and 16 h, photoperiods while in the second experiment the day lengths were 8, 11, 12, 13 and 18 h, for two tropical onion varieties (Samarn 5' and RD 77'). This gave a total

of 10 treatment combinations in each experiment. Forty black polythene plant bags each measuring 25 cm in diameter and 25cm deep were filled to 5cm from top with sandy loam top soil, well rotted farmyard manure and clean river sand in the ratio of 3:2:1. The soil component was sterilized in an electric soil sterilizer set at 212°F for 60 min and was stored for 14 days before used.

The pH of the soil in water determined using Beckman pH meter was 6.2. The potting medium was dispersed in water at a ratio of 20g soil to 40 ml of water. Five airy but dark compartments, each measuring 110 cm high and 70cm square at the top and base were constructed with hardwood and thick black cotton materials. The forty bags containing sixteen onion plants each were randomly allocated to the five chambers. Four of the eight bags in each chamber were sown with one of the two varieties.

The compartments used for the 8, 10 and 11 h treatments were each covered with a double layer of the black cotton material as blind. The blind materials were rolled up at 06.00 h daily and lowered at 14.00, 16.00 and 17.00 h to correspond with 8, 10 and 11 h supply of light, respectively.

To achieve the 13, 14, 16 and 18 h light durations, the day length was extended with one 40w Atlas tropical daylight fluorescent tube and one 60w incandescent bulb to 17.00, 18.00, 20.00 and 22 h for 13, 14, 16 and 18 h. This light source gave an irradiance of 1,400 lux at plant height [7]. Data were taken and recorded on plant height (cm), leaf length (cm), days to bulbing, was recorded as the mean number of days from sowing to visible swelling of the leaf bases, number of leaves and fresh weight (g) of bulb. The data collected were transformed by square root method [8] for easy of analysis and means were separated according to Okporie [9].

## RESULTS AND DISCUSSION

**Experiment I:** Results of experiment 1 are presented in Table 1. Onion variety Samaru 5 grew tallest at 10 h of day length. This differed significantly ( $p = 0.05$ ) from the heights of 12 and 14 h photoperiods. Similarly, RD77 at 10 h of day length was significantly taller than at 8, 12 and 14 h photoperiods. In both Samaru 5 and RD77, leaf length was increased progressively with increasing in day length. However, the leaves at 16 h day length were significantly longer than those at 8 h and 10 h of day length. There was also a significant difference in leaf length between 14 h and 8 h of light in the two varieties. Both Samaru 5 and RD 77 responded almost in the same pattern to different day lengths except that in Samaru 5, the number of leaves produced at 8 and 10 h of day length showed significant differences between 12, 14 and 16 h, while in RD77, only onion plants at 10 h photoperiod produced the highest number of leaves. The number of days to bulbing in both Samaru 5 and RD77 showed no significant differences between the photoperiods except that, in Samaru 5, the onion plants under 12 h of day length showed significant difference over 14 and 16 h photoperiods. There was no bulbing at photoperiods below 10 h in both varieties. With respect to fresh bulb weight, the two varieties did not bulb at photoperiods below 10 h; but the bulbs produced thereafter increased progressively with increase in day length.

**Experiment II:** Results of experiment II are presented in Table II. Samaru 5 grew tallest at 11 h photoperiod and was significantly different ( $P = 0.05$ ) from 8, 12 and 13 h of day length. This was followed by 18 h photoperiod which differed significantly from 12 and 13 h photoperiods only. In RD 77, the tallest plants were recorded at 11 and 13 h photoperiods and differed significantly from the plants

Table 1: Effects of day length on the vegetative and bulbing characters of two tropical onions at 8, 10, 12, 14 and 16 h of photoperiod in 2000

Photoperiod	Plant height (cm)		Leaf Length (cm)		Leaves/plant		Days to bulbing		Fresh bulb weight (g)	
	Samaru 5	RD 77	Samaru 5	RD 77	Samaru 5	RD 77	Samaru 5	RD 77	Samaru 5	RD 77
8	56.50	52.42	28.00	26.28	11.67	9.42	0.71	0.71	0.71	0.71
10	58.00	58.62	28.98	28.80	12.33	12.08	0.71	0.72	0.71	0.71
12	53.75	47.90	29.90	29.48	8.80	9.08	10.01	10.61	5.03	3.92
14	52.92	50.42	30.53	30.23	9.00	9.25	9.88	10.54	5.37	4.31
16	56.50	56.54	31.90	30.83	9.55	10.50	9.77	10.47	6.04	4.73
F-LSD <sub>05</sub>	3.80	5.15	2.37	2.52	1.29	1.81	0.299	0.427	0.71	0.59

Table 2: Effects of day length on the vegetative and bulbing characters of two tropical onions at 8, 11, 12, 13 and 18 h of photoperiod in 2002

Photoperiod	Plant height (cm)		Leaf Length (cm)		Leaves/ plant		Days to bulbing		Fresh bulb weight (g)	
	Samaru 5	RD 77	Samaru 5	RD 77	Samaru 5	RD 77	Samaru 5	RD 77	Samaru 5	RD 77
8	67.23	72.85	38.18	40.45	10.25	10.38	0.71	0.71	0.71	0.71
11	79.03	76.40	45.23	43.04	11.13	11.00	9.07	9.47	4.90	4.57
12	62.88	67.13	49.28	46.25	10.63	9.63	8.46	8.45	8.42	7.78
13	63.80	76.85	53.18	50.18	9.13	8.75	8.26	8.38	8.58	8.27
18	70.23	60.65	56.93	55.78	8.63	9.13	8.14	8.26	9.14	8.35
F-LSD <sub>05</sub>	6.51	9.15	4.63	6.56	0.98	0.91	0.184	0.156	0.808	0.849

at 12 and 18 h photoperiod. It was observed that in both Samaru 5 and RD 77, the leaves increased in length as day length increased. However, the leaves at 13 and 18 h photoperiods were significantly ( $P = 0.05$ ) longer compared to those under 8, 10 and 12 h photoperiod. It was observed that the number of leaves per plant in Samaru 5 at 8, 11 and 12 h day length were more than the number produced at 13 and 18 h photoperiod. In RD 77, plants grown at 11 h of light produced the highest number of leaves per plant. The number of days from planting to bulbing in both varieties decreased as day length progressed. In Samaru 5, 11 h photoperiod was significantly greater than 12, 13 and 18 h photoperiod. The 12 h photoperiod was significantly greater than 13 h and 18 h day length. RD 77, significantly ( $P = 0.05$ ) bulbed later at 11 h photoperiod over 12, 13 and 18 h day length. 12 h photoperiod was significantly greater than 18 h photoperiod. There was no bulbing in both samaru 5 and RD 77 at 8 h photoperiod. The fresh bulb weight of both varieties was increased progressively as day length increased. However, 11 h day length produced bulbs whose fresh weight was significantly smaller ( $P = 0.05$ ) than those at 12, 13 and 18 h photoperiod. There was no bulb initiation at 8 h photoperiod.

Generally, light duration had substantial influence on the vegetative and bulbing of the onion plants. However, it was observed that plant heights and number of leaves per plant was not directly proportional to increase in photoperiod because in plant heights; plants under 11 h photoperiod whose heights were tallest were not the longest photoperiod. This situation is proving that height and number of leaves per plant was not under photoperiodic control.

With respect to the plants' leaf lengths, it was observed that leaf length was directly proportional to increase in day length. Thus, it could be said that leaf length was under photoperiodic control. This pattern of response is expected of leaf length since the leaf is the organ of perception of photoperiodic stimulus and it followed the same response pattern as bulbing.

These findings are in agreement with the reports of Hussani *et al.* [10] and Abubakar [6] and Currah [11].

Bulbing of the tropical onion shows a clear response to long day treatment. This can be described from the failure of the plants to bulb at all under 8 and 10 h of day length. Bulbing occurred largely under long day conditions from 11 to 18 h, although, it took a longer time for plants at 11 h photoperiod to start bulbing. This is totally in disagreement with the general believe that only plants adapted to regions far away from the equator respond distinctly to photoperiods and agreed with the findings of (5) that tropical plants do respond to short variations in day-length (3 and 11)

## CONCLUSIONS

With the short intervals taken around 12 h of light duration, it can then be precisely said that bulbing of the tropical onion occurs as from 11 h upwards with greater and faster bulbing as the light duration increases. Thus, confirming that bulbing in the tropical onion is clearly a long day response.

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