Relation of Photoperiod to Diecision of Topmost Ear-Producing Node in *Zea Mays* L.*

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Fig. 1 Period of continuous short day condition in each treatment.

Note:—Indicate period receiving a photoperiod of 8 hr. of light and 16 hr. of darkness.

Table 1. Differentiation of tassel at various growth stage under different short day condition.

Date	June 15	July 1	July 15	Aug. 1	Sept. 1	Oct. 1	Tasseling date
Treatments	cm						
A	a	0.01	0.01	0.03	4.2(d)	19.7	Oct. 4
B	a	0.01	0.02	0.05	6.0(d)	20.4	Oct. 3
C	a	0.07	0.2(b)	0.6	(e)		
D	a	0.07	0.5(c)	14.1(d)	21.9		Aug. 14
E	a	0.07	0.5(c)	25.4(d)	25.5		Aug. 7
F	a	0.07	0.5(c)	25.4(d)	26.8		Aug. 4
G	a	0.09(b)	0.3(c)	18.6(d)	23.0		Aug. 7
H	a	0.01	0.1(b)	12.4(d)	21.6		Aug. 18
I	a	0.01	0.01	0.2(b)	19.4		Aug. 22
J	a	0.01	0.01	0.03	9.4(d)	16.2	Sept. 15

Notes: a) Just before tassel differentiation. b) Branch differentiation. c) Spikelet differentiation. d) Pollen differentiation. e) Proliferous tassel.

Table 2. Differentiation of ear (axillary shoot) at various growth stage under different short day condition.

Date	June 15	July 1	July 15	Aug. 1	Sept. 1	Oct. 1	silking date
Treatments	cm						
A	a	0.01	0.02	0.03	1.6(d)	18.5	Oct. 10
B	a	0.01	0.02	0.03	1.2(d)	16.4	Oct. 11
C	a	0.03	0.04	0.07	(e)	(f)	
D	a	0.03	0.08(b)	12.0(c)	19.2	26.4	Aug. 29
E	a	0.03	0.08(b)	14.3(c)	29.2	34.6	Aug. 17
F	a	0.03	0.08(b)	14.3(c)	32.0	32.4	Aug. 15
G	a	0.03	0.08(b)	9.0(c)	19.6	19.9	Aug. 19
H	a	0.01	0.03	6.4(b)	18.8	19.8	Aug. 24
I	a	0.01	0.02	0.06	17.6(c)	18.0	Aug. 27
J	a	0.01	0.02	0.03	8.4(c)	16.4	Sept. 20

Notes: a) Just before axillary shoot differentiation. b) Differentiation of the spikelet. c) Differentiation of the floret. d) Differentiation of the empty glume. e) Ufunctional axillary shoot. f) Trace of axillary shoot.

As topmost ear-producing height has relations with lodging, it is important to investigate the mechanism determining topmost ear-producing node. Most workers assumed that variation of topmost ear-producing height was the result of differential enviroment, but the authors are aware of no previous study on relation of photoperiod to the topmost ear producing node. The present study deals with the effect of photoperiodism in determining topmost ear-producing node.

Material and method The variety of corn used was Yucatan No. 16 which is one of the most photoperiodically sensitive varieties of corn as already known. On May 22 seeds were sown in the glass-room. In this series there are ten treatment as shown Fig. 1. Plants of control (A) received natural day length throughout their life-history. Three plants of each treatment were collected on June 15, July 1, July 15, August 1, September 1 and October 1. All leaves were removed without injury to the shoot apex under a dissecting microscope and we traced anatomically process of differentiation of apex and axillary shoot. Nodes of all plants were numbered from the base to the apex, the first node above the cotyledons being tagged as node 1.

Results Mean data for each stage of shoot apex and for its lenght were given in table 1, 2 and 3. The ten different treatments during the three month of photoinductive treatment gave rise to various stages in the process differentiating of the shoot apex and apex as follow:

On July 15 C had then received 15 days of natural long day after 30 days of short day treatment. The

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Table 3. Topmost ear (axillary shoot) bearing node number and total number of nodes.

Date	June 15	July 1	July 15	Aug. 1	Sept. 1	Oct. 1	a	b
Treat- ments	node							%
A	6	13	18	22	31	31	40	77.5
B	6	13	18	20	30	30	39	76.9
C	6	13	16	20				
D	6	13	16	16	16	16	22	72.7
E	6	13	16	16	16	16	22	72.7
F	6	13	16	16	16	16	23	69.6
G	6	13	16	16	16	16	23	69.6
H	6	13	16	18	18	18	24	75.0
I	6	13	18	19	22	22	28	78.5
J	6	13	18	22	24	24	31	77.4

Notes: a) Total number of nodes.

b) $\frac{\text{Topmost ear bearing node number}}{\text{Total number of nodes}} \times 100$

apex which was vegetatively growing on July 1 had changed considerably after receiving only 15 additional days of natural long day. Its apex was 2.1 mm in length and branch initial differentiated in acropetal succession from a previously formed central axis, but spikelet initial did not differentiate on central axis, that is to say the apex was transitional stage in the formation of the inflorescence. Axillary shoot differentiate to node 16 and was 0.4 mm long, but spikelet initial did not differentiate. D received short day for 45 days and the inflorescence was 5.5 mm long. The spikelet initial differentiated on central axis of apex. Axillary shoot, the future topmost ear, was differentiate at node 16 and 0.8 mm long. Spikelet initial differentiated on its shoot. G had received 30 days of short day after 15 days of natural long day. Axillary shoot differentiated to node 16. The shoot on which spikelet initial differentiated was become topmost ear. H had received short day for 15 days after 30 day of natural long day. Axillary shoot differentiated to node 16 and it was 0.2 mm long, but no spikelet initial differentiated on it.

On August 1 In A and B, the apex and axillary shoot continued to be vegetative. In C branch initial elongated abnormally, its length was 6 mm but no spikelet initial differentiated. Proliferous tassel on these plant began to appear on August 1 when plant had received natural long day for 30 days after 30 day of short day. Axillary shoot was as nearly large as that of previous stage. Axillary shoot did not differentiate at node which was higher than node 16. The spikelet was differentiated on apex in D and it was 1.6 mm long and more. The stamens were differentiated into anther and the anther is 0.6 mm long. Topmost axillary shoot is 22 mm long and floret differentiated on it. In the development of the inflorescence of H topmost

axillary shoot differentiated at node 18 and was 6.4 cm in length, and spikelet differentiated on it. In I, plant had received short day continuously for 30 days after 45 days of natural long days, and axillary shoot differentiated to node 19 but spikelet did not differentiated.

On september 1 Dissection of representative stem tip in A and B showed that plants had inflorescence of about 4.2 and 6.0 cm long, and had floret and antheral initial. These continued vegetative growth untill the late of August, plant having as many as 41 nodes by this time. Axillary shoot differentiated to node 30 and 31 and its length was 1.6 and 1.2 cm respectively. These axillary shoot on which glume differentiated became in future topmost ear. In J apex was 9.4 cm in length and had anther. Axillary shoot differentiated to node 24 and was 8.4 cm long, floret differentiated on it.

Discussion The variety of corn used (Yucatan No. 16) was essentially a short day plant. In the control floral did not differentiated untill the natural day length decreased in August, about 80 day after the planting date. Axillary shoot differentiated to node 31 and it became topmost ear. Therefore it is conjectured that if plant was grown under long day conditions of at least 18 hour of light by supplementing the natural day light with fluorescent lamps, axillary shoot will differentiate to the nodes which is higher than node 31.

In B vegetative growth rate of plant did not accelerated, indicating that photoinduction during 15 days did not effect the decision of topmost ear-producing node.

By receiving short day for 30 days branches in C were appeared around the central axis of apex and differentiation of axillary shoot was suppressed at node which was higher than the node that axillary shoot had differentiated. If afterward plant receive natural long day, vegetative development of inflorescence parts occur again and proliferous tassel appear on it apex. When the natural day length decreased, if branches of the staminate inflorescence was carefully dissected, large branch which had ten internodes and one or two axillary shoot developed in the axil of the leaves would be observed and small branch which had a few spikelets that had either staminate or pistillate would be observed. But no axillary shoot again differentiated on main stem. Therefore it is conjectured that physiology of axillary shoot differentiation on main stem was independent on that of tassel proliferation. Proliferation in the tassel of C 31 id (*Zea mays* L.) has since been repoted by Galinate.

In D tassel initial differentiated between July 1 and 15. It was infered that apparently

uppermost node which possessed a shoot that has passed a certain stage in its development in the term become the uppermost ear-producing node and no axillary shoot differentiated at node which was higher than these nodes. Difference of ear differentiation between C and D attributed to difference of short day between July 1 and 15.

Plant of E silked on August 17th, about 86 days after planting. Topmost ear differentiated at node 16, and tasseling and silking was normal. It indicated that length of photoinduce in these plot were enough period to differentiate floret.

G had not received short day between June 1 and 15 but floral differentiated between July 1 and 15 as well as E, indicating short day treatment between June 1 and 15 did not effect differentiation of floral. Apex of plant in H received short day treatment only between July 1 and 15 was still vegetative on July 15, indicating short day treatment only between July 1 and 15 was not enough period to differentiate complete floral.

Length of treatment period which plant of C treatment received was as long as that of J. In C photoinduce was incomplete, while in J photoinduce was complete and floral differentiated on tassel and ear. It was suggested that seedling of this variety required a much longer time to flower after being given the proper photoperiodic treatment than do older plant, indicating age was closely relative to response. The minimum number of leaves on flowering plants of this strain yet observed was 22. It was probable

that a certain age, size or leaf area must be attained before floral initiation could take place. That is to say a hypothesis is that the tissues must be of a certain age before the stimulus which promote flowering become effective in altering the pattern of development of the terminal meristem.

The later plant receive short day, the later floret differentiate, therefore the later tassling occurred. Thus short photoperiod has a distinctly accelerative effect on the reproductive phase. While in any stage plant may received short day treatment, relation of topmost ear-producing node number to total number of node constant approximately. The ratio is about three-fourths.

As the plant was grown, number of node were successively increased above untill the lateral branches of the tassel start to appear. As soon as branches of the tassel differentiate, the node which is higher than what have differentiated at the time is suppressed differentiation of axillary shoot. Therefore it was inferred that there was relation correlatively between differentiation of tassel and ear. While temperature may has had some influence to decision of ear producing node, but there were not taken into account, because the authors had found that the decision of ear bearing node were slightly effected by the different temperature by the previous glass-room test.

Literature

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〔和 文 摘 要〕

とうもろこしの着雌穂節位に及ぼす日長時間の影響

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とうもろこしの着雌穂高は倒伏性と密接な関係にあるので着雌穂位置の低いことは育種上並に栽培上重要なことである。着雌穂高は移植、低温、遮光処理等によつて変ることを知つたがその中で最も顕著な影響を示すのは日長処理であつた。日長処理と着雌穂節位の関係を究明するため本実験では処理期間に着雌穂節位に及ぼす影響について実験を行なつた。処理を明期 8 時間暗期 16 時間とした場合 yucatan No. 16 では処理を生育の後期に行う程着雌穂節位は上昇し日照と深い関係がある。又処理を播種後 20 日目頃から 40 日間続けることにより最も早期に雌穂が分化した。たとえこれより早期に処理しても効果のないことから考えて花芽の分化の爲めには処理前に植物体がある大きさに達していることが必要である。雄穂が分化すると共に側芽の節位的分化は抑えられそのときの最上側芽が雌穂となり、雄穂と雌穂の分化との間にある連関のあることを示す。処理時期の如何に拘わらず全節数と着雌穂節位の比はほぼ $3/4$ である。