

## RESEARCH ON GROWTH AND DEVELOPMENT OF NEW HYBRID MAIZE VARIETIES IN THE SPRING OF 2018 AT SOME PROVINCES IN NORTHERN AND NORTH CENTRAL REGION

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### ABSTRACT

The researchers evaluated the growth and development ability of some hybrid maize varieties grown in Spring 2018 in 4 northern and north central provinces including Viet Tri - Phu Tho, Vinh Tuong - Vinh Phuc, Phu Yen - Son La, Yen Dinh - Thanh Hoa. The experiments were arranged in a completely randomized block format with 3 replicates. Each hybrid maize was cultivated in 4 rows in a 5-m long plot; the distance between two rows was 70 cm and the distance between two plants was 25 cm. Fertilizers applied generally for experiments were 150 kg N + 90 kg P<sub>2</sub>O<sub>5</sub> + 80 kg K<sub>2</sub>O/ha. The results showed that the growth time of experimental hybrid maize varieties in Viet Tri - Phu Tho ranged from 122 to 127 days, in Vinh Tuong - Vinh Phuc ranged from 117 to 120 days, in Phu Yen - Son La fluctuated from 113 to 116 days, in Yen Dinh - Thanh Hoa from 97 to 105 days. Experimental hybrid maize varieties belong to the group with middle - day growing time, suitable to ecological conditions and farming practices of the people. In the Spring crop in 4 research provinces, four varieties of T18-1, TA17-1, CNC352, VN117 were highly productive, quite stable and relatively adaptable. In addition, four varieties namely TM16-2, TM18-2, VN667, and MRI9 had high yield, were quite stable and relatively adaptable in three provinces.

**Key words:** hybrid maize variety; productive; stable; development; north; growth

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## NGHIÊN CỨU KHẢ NĂNG SINH TRƯỞNG VÀ PHÁT TRIỂN CỦA CÁC GIỐNG NGÔ LAI MỚI VỤ XUÂN 2018 TẠI MỘT SỐ TỈNH MIỀN BẮC VÀ BẮC TRUNG BỘ

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### TÓM TẮT

Trong vụ Xuân 2018 tại 4 tỉnh phía Bắc và Bắc Trung Bộ gồm Việt Trì – Phú Thọ, Vĩnh Tường – Vĩnh Phúc, Phú Yên – Sơn La; Yên Định – Thanh Hóa, nhóm nghiên cứu đã tiến hành đánh giá khả năng sinh trưởng, phát triển của một số giống ngô lai. Các thí nghiệm được bố trí theo kiểu khối ngẫu nhiên hoàn toàn với 3 lần nhắc lại. Mỗi giống ngô lai trồng 4 hàng trong một ô dài 5 m, khoảng cách giữa hai hàng là 70 cm, khoảng cách giữa hai cây là 25 cm. Mức phân bón được áp dụng chung cho các thí nghiệm là 150 kg N + 90 kg P<sub>2</sub>O<sub>5</sub> + 80 kg K<sub>2</sub>O/ha. Kết quả cho thấy: Thời gian sinh trưởng của các giống ngô lai thí nghiệm ở Việt Trì – Phú Thọ biến động từ 122 - 127 ngày, ở Vĩnh Tường – Vĩnh Phúc biến động từ 117 - 120 ngày, ở Phú Yên – Sơn La biến động từ 113 - 116 ngày, ở Yên Định – Thanh Hóa biến động từ 97 - 105 ngày. Các giống ngô lai thí nghiệm đều thuộc nhóm có thời gian sinh trưởng trung ngày, phù hợp với điều kiện sinh thái và tập quán canh tác của người dân. Trong vụ Xuân tại 4 tỉnh nghiên cứu, bốn giống TM18-1; TA17-1; CNC352; VN117 có năng suất cao, khá ổn định và tương đối thích nghi. Ngoài ra, có bốn giống TM16-2; TM18-2; VN667, MRI9 cho năng suất cao, khá ổn định và tương đối thích nghi tại 3 tỉnh.

**Từ khóa:** Giống ngô lai; năng suất; ổn định; phát triển; phía Bắc; sinh trưởng.

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## 1. Introduction

Maize (*Zea mays* L.) is one of the three important food crops in the world economy. Although only 17% of total maize production is used for food but maize is the main food crop that contributes to one-third of the world's population, ensuring national food security. Maize is a feed source, about 70% of the concentrate in animal feed comes from corn. In Vietnam, although maize accounts for only 12.1% of the food crops area, it has the second most important significance after rice [1]. According to data from the General Statistics Office of Viet Nam in 2019 [1], the country's maize area in 2018 was 1.04 million hectares, the yield reached 47.2 quintals/ha, production amount of 4.91 million tons. The Northern and Northern Central provinces are the major maize producing regions of Vietnam. The total maize area of these provinces is 721.4 thousand ha; the average yield is 44.9 quintals/ha; and the output is 3,043 thousand tons. However, the productivity of the regions is very different. The Red River Delta has the highest productivity of 49.6 quintals/ha; the North Central Coast is 45.8 quintals/ha; the Northern Midlands and Mountains is 39.4 quintals/ha [1].

These regions use many of the best intensive maize varieties on the market today. The annual demand for maize seeds is about 14,400 tons/year, which is a potential market for seed companies to produce and trade maize seeds. The testing of elite hybrid maize by companies in these regions has been focused. New varieties that are considered good must have high yield, good agronomic characteristics, stability, high adaptability to different environmental conditions to increase the reliability of the breed [2], [3], [4], [5], [6], [7]. The structure of maize varieties suitable for high yield and stable growth in the Northern and Northern Central provinces is very limited. Therefore, it is necessary to diversify and diversify sources of maize varieties in these regions, and at the same time select and find the best maize varieties to put into production. Therefore, it is necessary

to conduct the research, evaluation and removal of unsuitable varieties, helping the maize production process to achieve the highest efficiency. This study presents the results of evaluating the growth and development ability of some new maize hybrids at some trial sites in 4 provinces in the North and North of Central to select suitable hybrid maize varieties. with ecological conditions to integrate the crop structure, contributing to improving the efficiency of maize production of the provinces in these regions.

## 2. Materials and method

### 2.1. Research materials

Including 12 new hybrid maize varieties selected by Maize Research Institute: MRI9, CNC352, TA16-4, TA17-1, TM16-2, TM18-1, TM18-2, VN117, VN667, ĐH18-1, ĐH18-2, VS89 with two control varieties NK7328 (*Syngenta Limited Company*) and CP511 (*CP Limited Company*).

### 2.2. Location and study time

- Location: Phuong Lau Commune - Viet Tri - Phu Tho (Midland), Vinh Tuong Town - Vinh Tuong - Vinh Phuc (Red River Delta), Huy Tuong Commune - Phu Yen - Son La (Northern Mountain Region) North); Dinh Hai commune - Yen Dinh - Thanh Hoa (North Central region).

- Research time: From February to July 2018 (Spring crop).

- Method of research: The experiment was arranged in a completely randomized block design (RCBD) including 14 formulas with 3 replications, including 4 experiments. The area of 1 plot was 14 m<sup>2</sup> (5 m x 2.8 m). The interval between repetitions was 1 m. Each seed sowed 4 rows/plot, row spaced 70 cm, tree spaced 25 cm away (density 5,700 stems/ha), sowed 2 seeds/recess and pruned to 1 stalk/hole. Fertilizers applied generally for experiments were 150 kg N + 90 kg P<sub>2</sub>O<sub>5</sub> + 80 kg K<sub>2</sub>O/ha. The tracking criteria are implemented in the middle 2 rows of the cell. There was a protective tape around the

experiment, at least 2 rows of maize width, distance, density as in the experiment. The monitoring criteria were conducted according to the National Technical Regulation on testing the value of cultivation and use of maize varieties following Vietnamese standards QCVN 01-56: 2011/BNNPTNT [8]. Experimental results were collected and synthesized on Excel 2010 software. The experiment data was statistically processed on computers under IRRISTAT 5.0.

### 3. Results and discussion

#### 3.1. Growth time of experimental hybrid maize varieties at 4 locations in Spring of 2018

Results of monitoring the growing time of experimental and control varieties at 4 locations in the Northern and North Central provinces are presented in Table 1.

Table 1 shows that the growth time of the experimental varieties and control varieties in Viet Tri - Phu Tho varied from 122 to 127 days. The three varieties CNC352, TA17-1 and VN667 had the shortest growing time (122 days), 3 to 5 days shorter than the control. The varieties TM16-2, TM18-2, TM18-1 had shorter growing time than control NK7328 from 3-4 days, shorter than control CP511 from 1-2 days. The varieties MRI9, TA16-4, VN117, VS89 had the growth time by the control CP511 (125 days) and 2 days shorter than the control NK7328. Two varieties DH18-1, DH18-2 had TG7328 by control (127 days), but longer than control CP511 by 2 days.

The growth time of the experimental and control varieties in Vinh Tuong - Vinh Phuc ranged from 117 to 120 days. Three varieties CNC352, TA17-1 and VN667 had the shortest growing time (117 days), shorter than the control 2-3 days. The varieties TM16-2, TM18-2, TM18-1 had the growth time shorter than the control NK7328 from 1-2 days. Two varieties TM16-2, TM18-2 had shorter

growth control than control CP511 from 1 day. The varieties TM18-1, DH18-2 had growth time by control CP511 (119 days) and 1 day shorter than NK7328. The varieties MRI9, TA16-4, VN117, DH18-1, VS89 had the growth time with NK7328 control (120 days), but 1 day longer than control CP511.

The growth time of the experimental and control varieties in Phu Yen - Son La ranged from 113 to 116 days. Two varieties TM18-1 and VN667 had the shortest growing time (113 days), 2-3 days shorter than the control. The varieties TM16-2, TM18-2, TM18-1 had growth time shorter than the control NK7328 from 1-2 days. Three varieties TM16-2, VN117, DH18-1 had the growth time shorter than control CP511 from 1 day, 2 days shorter than control NK7328. The varieties CNC352, TA16-4, TM18-2, DH18-2 had growth time by control of CP511 (115 days) and 1 day shorter than NK7328. The varieties MRI9, TA16-1, VS89 had growth time with NK7328 control (116 days), but longer than control CP511 by one day.

Growth time of experimental and control varieties in Yen Dinh - Thanh Hoa ranged from 101 - 105 days. Only VN117 has the shortest growing time (101 days), 3 - 4 days shorter than the control. Like TM18-1, the growth time was 102 days shorter than the control of 2-3 days. The varieties CNC352, TA17-1, TM16-2, had the growth time shorter than the control from 1-2 days. Three varieties, MRI9, TA16-4, DH18-1, had TG511 word control (104 days), 1 day shorter than NK7328 control. The varieties TM18-2, DH18-2, VS89 had growth time by NK7328 control (105 days), but longer than control CP511 by 1 day.

The experimental and control varieties were in the group of medium growing, suitable for the rotation formula of Northern and Northern Central provinces.

**Table 1.** Growth time of experimental hybrid maize varieties at 4 locations of Spring 2018 crop (days)

Order	Varieties	Viet Tri – Phu Tho	Vinh Tuong - Vinh Phuc	Phu Yen - Son La	Yen Dinh - Thanh Hoa
1	MRI9	125	120	116	104
2	CNC352	122	117	115	103
3	TA16-4	125	120	115	104
4	TA17-1	122	117	116	103
5	TM16-2	123	118	114	103
6	TM18-1	124	119	113	102
7	TM18-2	123	118	115	105
8	VN117	125	120	114	101
9	VN667	122	117	113	105
10	ĐH18-1	127	120	114	104
11	ĐH18-2	127	119	115	105
12	VS89	125	120	116	105
13	NK7328 (control 1)	127	120	116	105
14	CP511 (control 2)	125	119	115	104

**Table 2.** Plant height and height of maize for hybrid maize varieties tested at 4 locations in Spring 2018 (cm)

Varieties	Viet Tri - Phu Tho		Vinh Tuong - Vinh Phuc		Phu Yen - Son La		Yen Dinh - Thanh Hoa	
	Tree height	Maize height	Tree height	Maize height	Tree height	Maize height	Tree height	Maize height
MRI9	195	97	225	120	181	84	221	115
CNC352	188	88	220	110	197	80	232	120
TA16-4	208	95	234	130	210	115	250	135
TA17-1	215	115	190	90	224	120	247	140
TM16-2	176	80	180	70	216	85	226	120
TM18-1	218	110	223	116	230	112	247	130
TM18-2	233	110	230	110	210	75	255	120
VN117	220	120	230	125	220	100	250	125
VN667	194	95	167	83	221	100	234	125
ĐH18-1	199	92	197	115	193	105	252	150
ĐH18-2	194	90	193	92	210	106	222	118
VS89	183	95	185	85	230	115	200	100
NK7328 (control 1)	190	98	180	80	190	98	233	120
CP511 (control 2)	174	70	180	75	178	78	201	89
<i>P</i>	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
<i>LSD</i> <sub>05</sub>	8.5	8.8	7.5	8.7	8.2	8.7	9.1	8.7
<i>CV</i> (%)	4.1	4.5	6.1	6.7	6.2	6.2	6.1	6.7

### 3.2. Morphological characteristics of experimental hybrid maize varieties at 4 locations of Spring 2018

Results of monitoring tree height of experimental and control varieties at 4 locations in Northern and North Central provinces are presented in Table 2.

The results obtained in Table 2 show that plant height of experimental and control varieties in Viet Tri - Phu Tho, reached from 174 to 233 cm. Including 9 varieties of tree height greater than both control from 4 - 33

cm. Particularly, control CP511 had the lowest tree height (174 cm); in Vinh Tuong - Vinh Phuc, reaching from 180 - 234 cm. Including 10 varieties of tree height greater than both control from 5 to 34 cm. Particularly, VN667 had the lowest tree height (167 cm); in Phu Yen - Son La, reaching from 178 to 230 cm. Including 11 varieties of tree height greater than both control from 3 - 30 cm. Particularly, control CP511 had the lowest tree height (178 cm); in Yen Dinh - Thanh Hoa, reaching from 200 to

255 cm. Including 7 varieties of tree height greater than both control from 1 to 22 cm. Particularly the control variety CP511 had the lowest tree height (201 cm). Statistical processing results showed that the differences among the experimental varieties in terms of tree height were significant at the 95% confidence level.

The results obtained in Table 2 show that: Maize height of experimental and control varieties in Viet Tri - Phu Tho, reached 70 - 120 cm. Including 12 varieties of height closed maize greater than both control from 10-45 cm. Particularly, control CP511 had the lowest height of maize closure (70 cm); in Vinh Tuong - Vinh Phuc, reaching from 75 - 130 cm. Including 12 varieties of height closed maize greater than both control from 10-45 cm. Particularly, control CP511 had the lowest height of maize closure (75 cm); in Phu Yen - Son La, reaching from 75 to 120 cm. Including 11 varieties of height closed maize greater than the control from 7- 42 cm. Particularly, TM18-2 variety had the lowest height of maize (75 cm); in Yen Dinh - Thanh Hoa, reaching from 89-150 cm. Including 12 varieties of height closed maize greater than the control from 11 to 61 cm. Particularly, the

control variety CP511 had the lowest height of maize closure (89 cm). The statistical treatment results showed that the differences among the experimental varieties in height of maize closure were significant at the 95% confidence level.

### 3.3. Resilience of experimental hybrid maize varieties at 4 locations in Spring of 2018

As shown in Table 3, in Viet Tri - Phu Tho, the experimental hybrid maize varieties infected with leaf spots were from 1 to 2. Only TA17-1 was infected with point 2. In Vinh Tuong - Vinh Phuc, experimental hybrid maize varieties infected with leaf spot fluctuated from point 1 to 3. There were two varieties with higher levels of infection (score 3). The strains of MRI9, CNC352, TA17-1, VN117, DH18-1, VS89 were the least infected (point 1). In Phu Yen - Son La, the experimental hybrids were infected with leaf spot ranging from 1 to 3. There were 7 varieties infected with very light, equivalent to NK7328 control (point 1). In Yen Dinh - Thanh Hoa, the experimental hybrids contaminated with leaf spot were from 1 to 3. The slightly affected varieties CNC352, DH18-1, VS89 were (very little). Both controls were slightly infected (point 2).

**Table 3.** The prevalence of leaf spot and sheath blight of hybrid maize varieties tested at 4 locations in Spring of 2018 (points 1 - 5)

Varieties	Viet Tri - Phu Tho		Vinh Tuong - Vinh Phuc		Phu Yen - Son La		Yen Dinh - Thanh Hoa	
	Leaf spot disease	sheath disease	Leaf spot disease	sheath disease	Leaf spot disease	sheath disease	Leaf spot disease	sheath disease
MRI9	1	2	1	1	2	2	2	3
CNC352	1	1	1	1	1	1	1	2
TA16-4	1	1	2	1	1	1	3	1
TA17-1	2	2	1	1	2	2	2	2
TM16-2	1	1	3	2	1	1	3	2
TM18-1	1	2	2	2	2	2	2	2
TM18-2	1	2	2	2	2	2	2	2
VN117	1	1	1	1	1	1	3	2
VN667	1	1	2	1	1	1	2	2
DH18-1	1	1	1	1	1	1	1	1
DH18-2	1	1	2	1	1	1	2	1
VS89	1	3	1	1	3	3	1	1
NK7328 (control 1)	1	2	3	1	1	2	2	2
CP511 (control 2)	1	1.5	2	1	1.5	2	2	2

Regarding sheath blight, in Viet Tri - Phu Tho, the infected hybrid maize varieties tested

ranged from point 1-3. In which VS89 was most infected at moderate level (score 3).

There were 7 varieties infected with very mild (point 1) infection slightly less than both controls. In Vinh Tuong - Vinh Phuc, infected varieties ranged from point 1 to 3. There were 3 varieties TM16-2, TM18-1, TM18-2 infected slightly (point 2). All the remaining varieties and the two controls were very lightly infected (point 1). In Phu Yen - Son La, the experimental hybrid maize lines infected with sheath ranged from point 1 to 3. Only VS89 variety was the most severely infected (score 3). There were 6 varieties with the slightest infection (point 1), the infection is milder than both controls. In Yen Dinh - Thanh Hoa, the experimental hybrid maize lines infected with sheath ranged from point 1 to 3. Only the MRI9 variety was the worst affected (moderate point 3). There were 4 varieties with the slightest infection (point 1), the infection is less than both control (score 2). At all 4 points, the varieties CNC352, DH18-1 were infected with the slightest leaf spot, the varieties TA16-4, DH18-1, DH18-2 were infected with the lightest sheath blight, lighter than the others and control varieties. The rooting level of the varieties is presented in Table 4. In Phu Tho, the rooted varieties

were VN116 (70%), TA17-1 (50%), DH18-2 (50%), DH18-1 (40%). The lighter spilled varieties were DO50 (20%), MRI9 (10%). The varieties that did not shed or shed little included VN117, VN667, TM18-1, LVN17, CNC352 and TA16-4.

In Vinh Phuc, most of the varieties fall due to strong cyclones. However, the level of rooting was also different. Heavy rooted varieties were TM18-1 (70%), TM18-2 (70%), DH18-1 (50%), TA16-4 (50%), TA17-1 (40%), TM16-2 (40%) and NK4300 (40%). The lighter shed varieties were VN667, VS89, CNC352, MRI9.

In Son La, there were 2 heavy rooted varieties: VN116 (50%), TM18-2 (30%). The remaining varieties did not shed or shed little. In Thanh Hoa, no breed was rooted.

Through 4 model points, it shows that some varieties with good rooting resistance included VN667, VN117, CNC352, LVN17. MRI9, CNC352, TA16-4, VN117, VN667, DH18-1, CP511 varieties had very minor body fractures (point 1) at all 4 model points. Particularly, TM18-2 variety had more body broken than other varieties (points 2 to 4).

**Table 4.** Degree of rooting and stem breaking of experimental hybrid maize varieties in 4 locations of Spring 2018

Varieties	Rooting rate (%)				Broken body (point 1-5)			
	Phu Tho	Vinh Phuc	Son La	Thanh Hoa	Phu Tho	Vinh Phuc	Son La	Thanh Hoa
MRI9	10	30	2	0	1	1	1	1
CNC352	3	20	1	0	1	1	1	1
TA16-4	5	50	0	0	1	1	1	1
TA17-1	50	40	3	0	1	1	2	1
TM16-2	5	40	3	0	1	1	2	1
TM18-1	1	70	2	0	1	2	2	1
TM18-2	5	70	30	0	2	4	2	1
VN117	0	0	0	0	1	1	1	1
VN667	1	10	0	0	1	1	1	1
DH18-1	40	50	0	0	1	1	1	1
DH18-2	50	40	2	0	2	2	1	1
VS89	30	30	2	0	1	2	1	1
NK7328(control 1)	5	20	2	0	1	2	1	1
CP511 (control 2)	5	20	2	0	1	1	1	1

### 3.4. Yield of experimental hybrid maize varieties at 4 sites of Spring 2018

Theoretical yield indicated the yield potential of varieties under certain growing conditions. As shown in Table 5, the theoretical yield of the hybrid maize varieties tested in Spring 2018

fluctuated among the points. In Viet Tri - Phu Tho, the crop budgets of participating varieties ranged from 66.02 to 96.45 quintals/ha. Statistical processing results showed that the theoretical yield of the varieties participating in the experiment was significantly different ( $P < 0.05$ ). There were two varieties with higher yield than the control NK7328 (82.36 quintals/ha), CP511 (85.80 quintals/ha). However, only TA16-2 variety yielded 96.45 quintals/ha, which was higher than the sure control variety with 95% confidence.

In Vinh Tuong - Vinh Phuc, the crop buds of the participating varieties ranged from 69.68 to 102.62 quintals/ha. Statistical processing results showed that the theoretical yield of the varieties participating in the experiment was significantly different ( $P < 0.05$ ). There were 12/12 varieties for the variety of energy content higher than the control NK7328 (69.68 quintals/ha) and 11/12 varieties for the amount of energy content higher than the control of CP511 (71.23 quintals/ha). However, only 6 out of 12 varieties were found to have higher yield than the two control varieties with 95% confidence. These

are MRI varieties (102.62 quintals/ha), TA16-2 (96.99 quintals/ha), CNC352 (84.32 quintals/ha), TM18-1 (84.18 quintals/ha), TM18-2 (82.06 quintals/ha) and VN117 (82.05 quintals/ha).

In Phu Yen - Son La, the crop buds of the participating varieties ranged from 73.05 to 106.79 quintals/ha. Statistical processing results showed that the theoretical yield of the varieties participating in the experiment was significantly different ( $P < 0.05$ ). There were 5/12 varieties with higher yield than the control NK7328 (79.35 quintal/ha) with 95% reliability (including TM18-1 reaching 106.79 quintals/ha; VS89 reached 99.88 quintal/ha; TM18-2 reached 92.24 quintals/ha; TA17-1 reached 91.82 quintals/ha and CNC352 reached 88.72 quintals/ha). There were 8/12 varieties with higher yield than the control CP511 (75.45 quintals/ha) with certainty of 95% confidence (In addition to 5 above-mentioned varieties and 3 University varieties 18-1 (86.44 quintals/ha); TA16-4 (86.40 quintals/ha) and DH18-2 (83.99 quintals/ha).

**Table 5.** Yield of hybrid maize varieties tested at 4 locations in Spring of 2018

Varieties	Theoretical yield (quintals/ha)				Real yield (quintals/ha)				
	Phu Tho	Vinh Phuc	Son La	Thanh Hoa	Phu Tho	Vinh Phuc	Son La	Thanh Hoa	Average
MRI9	83.99	102.62	78.29	89.07	71.44	60.21	60.55	75.66	66.97
CNC352	84.06	84.32	88.72	84.02	66.13	66.44	81.86	75.17	72.40
TA16-4	71.42	76.40	86.40	78.52	56.83	55.87	74.03	68.19	63.73
TA17-1	74.03	75.21	91.82	93.58	65.12	60.02	83.31	70.13	69.65
TM16-2	96.45	96.99	73.05	92.78	79.32	67.70	53.92	70.01	67.74
TM18-1	85.53	84.18	106.79	94.69	79.34	59.65	95.13	75.16	77.32
TM18-2	78.03	82.06	92.24	84.60	73.82	61.10	82.56	75.30	73.20
VN117	72.78	82.05	80.33	94.83	60.71	71.18	69.64	66.24	66.94
VN667	79.70	74.88	78.63	66.24	62.05	57.87	69.02	50.21	59.79
DH18-1	69.54	71.89	86.44	71.46	52.96	55.05	77.94	60.93	61.72
DH18-2	66.02	70.14	83.99	74.08	56.31	54.78	72.04	59.83	60.74
VS89	87.95	79.66	99.88	75.29	57.69	58.01	89.90	57.33	65.73
NK7328 (control 1)	82.36	69.68	79.35	85.04	67.52	59.41	69.52	77.01	68.36
CP511 (control 2)	85.80	71.23	75.45	79.05	68.37	60.21	65.74	68.45	65.69
<i>P</i>	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
<i>LSD</i> <sub>05</sub>	6.30	10.80	7.20	9.50	5.63	6.35	12.3	5.4	
<i>CV</i> (%)	5.30	7.20	9.80	7.50	9.1	8.4	9.5	9.3	

In Yen Dinh - Thanh Hoa, the crop budgets of participating varieties ranged from 71.46 to 94.83 quintals/ha. Statistical processing results showed that the theoretical yield of the varieties participating in the experiment was significantly different ( $P < 0.05$ ). There were 2/12 varieties with higher yield than the control NK7328 (85.04 quintals/ha) with 95% reliability (including VN117 with 94.83 quintals/ha; TM18-1 reaching 94.69 quintal/ha).

There were 5/12 varieties with higher yield than the control CP511 (79.05 quintals/ha) with certainty of 95% confidence (In addition to the two above-mentioned varieties and 3 varieties, TA17-1, reaching 93.58 quintals/ha; TM16-2 reached 92.78 quintals/ha; and MRI9 reached 89.07 quintals/ha). The varieties with high theoretical productivity at 3/4 points were TM16-2 and TM18-1; 2/4 points were MRI9; CNC352; TA17-1; TM18-2 and VN117; 1/4 point was VS89.

In terms of actual yield, true yield is the most important indicator in hybrid maize breeding. Net yields (chromosomes) are the ultimate goal that breeders and producers aim to, the chromosome is a composite indicator of many factors such as varieties, care conditions (fertilizers, irrigation water, amount of rain...). Varieties with high yield potential can only exert that potential when nurtured under appropriate conditions. Therefore, in the same climatic conditions, soil, the regime of taking care of suitable new breeds has the ability to grow and develop, resist well and give high productivity.

Table 5 shows that the actual yield of the hybrid maize varieties tested in Spring 2018 fluctuated among points. In Viet Tri - Phu Tho, the chromosome of the varieties participating in the experiment ranged from 52.96 to 79.34 quintals/ha. Statistical processing results showed that the actual yield of the varieties participating in the experiment was significantly different ( $P < 0.05$ ). There were two varieties, TM16-2 (79.32 quintals/ha) and TM18-1 (79.34 quintals/ha) for chromosomes higher than the two control NK7328 (67.52 quintals/ha), CP511 (68.37 quintals/ha) with a 95% confidence level. There were 3/12 varieties for chromosome higher than control NK7328 with 95% confidence level (In addition to the two varieties mentioned above and TM18-2 variety reached 73.82 quintals/ha).

In Vinh Tuong - Vinh Phuc, the chromosome of the varieties participating in the experiment ranged from 54.78 to 71.18 quintals/ha. Statistical processing results showed that the theoretical yield of the varieties participating in the experiment was significantly different ( $P < 0.05$ ). There were 2/12 varieties for chromosomes higher than the two control NK7328 (59.41 quintals/ha) and CP511 (60.21 quintals/ha). These were the varieties TM16-2 (67.70 quintals/ha) and VN117 (71.18 quintals/ha). There were 3/12 varieties for chromosome higher than control NK7328 with 95% confidence level (In addition to the two above-mentioned varieties and CNC352 varieties, reaching 66.44 quintals/ha).

In Phu Yen - Son La, the chromosome of the varieties participating in the experiment ranged from 53.92 - 95.13 quintals/ha. Statistical processing results showed that the theoretical yield of the varieties participating in the experiment was significantly different ( $P < 0.05$ ). There were 5/12 varieties with higher chromosome than control NK7328 (69.52 quintals/ha), CP511 (65.74 quintals/ha) with 95% reliability, including TM18-1 varieties reaching 95, 13 quintals/ha; VS89 reached 89.90 quintals/ha; TA17-1 reaches 83.31 quintals/ha; TM18-2 reached 82.56 quintals/ha and CNC352 reached 81.86 quintals/ha.

In Yen Dinh - Thanh Hoa, the chromosome of the varieties participating in the experiment ranged from 50.21 to 77.01 quintals/ha. Statistical processing results showed that the theoretical yield of the varieties participating in the experiment was significantly different ( $P < 0.05$ ). There was no variety for the chromosome higher than the control NK7328 (77.01 quintals/ha) with 95% confidence level. However, there were 4/12 varieties for chromosome higher than for CP511 (68.45 quintals/ha) with 95% reliability, including MRI9 varieties (75.66 quintals/ha); TM18-2



(75.30 quintals/ha); CNC352 (75.17 quintals/ha) and TM18-2 (75.16 quintals/ha).

In summary, at 4 experimental sites, the varieties with the highest net yield at 3/4 points were TM18-1 and TM18-2; 2/4 points are CNC352; TM16-2; 1/4 point was VS89, VN117, TA17-1, MRI9. The varieties with high yield of 2-3 points showed quite stable and relatively adaptable in the study areas.

#### 4. Conclusions

- The growth time of the hybrid maize varieties tested in the Spring 2018 varied from 122 - 127 days in Viet Tri - Phu Tho; ranged from 117 - 120 days in Vinh Tuong - Vinh Phuc; fluctuated from 113 to 116 days in Phu Yen - Son La and from 101 to 105 days in Yen Dinh - Thanh Hoa. The experimental hybrid maize varieties belonged to the group with medium growing time, suitable for the rotation formulas in the Northern and Northern Central provinces.

- Experimental hybrid maize varieties with average plant height and height.

- In all 4 study sites, experimental hybrid maize varieties were resistant to mottling disease, moderate to fairly dry. Two varieties CNC352, DH18-1 were infected with the slightest leaf spot at all 4 points, two strains DH18-1, DH18-2 were infected with the slightest sheath blight at all 4 points lighter than the other varieties and the two control varieties.

- Through 4 research sites, the varieties with high net yield at 3/4 points were TM18-1 and TM18-2; 2/4 points were CNC352; TM16-2. These varieties appeared to be quite stable and relatively adaptable in the study areas.

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