

Morphological and Genetic Diversity of Waxy Maize Landraces in Vietnam

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ABSTRACT

Vietnam's indigenous waxy maize varieties are highly diverse in types, colours, and genetic makeup, with strong adaptability and resilience. A collection of these indigenous waxy corn varieties has been gathered and preserved at the Maize Research Institute and the Plant Resources Center, comprising 200 varieties, primarily originating from northern provinces. In this research, a total of 54 SSR primers were analysed across a set of 200 waxy maize varieties, of which 21 produced polymorphic alleles. The analysis yielded 104 allele types, with an average of 4.95 alleles per SSR primer. The average Polymorphism Information Content (PIC) of the 21 polymorphic primers is 0.55. Based on genetic distance among varieties, the collected Vietnamese waxy maize can be divided into 6 subgroups. In addition, agronomic traits related to yield, such as plant height, dry weight, cultivation duration, ear length, and ear diameter also showed differences among the six genetic groups of Vietnamese waxy maize.

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1. Introduction

Glutinous maize (*Zea mays* var. *ceratina*), commonly known as waxy maize, is a vital staple and economic crop in Asia countries, especially in China and Vietnam. In the waxy grain characteristic, almost all starch in the grain endosperm is amylopectin, which is suitable for fresh consumption due to its fragrant aroma and characteristic sticky texture (Cengiz, 2022; Liet et al., 2017; Xiao-yang et al., 2022; Zheng et al., 2013). Local waxy corn landraces in Vietnam, especially in the northern mountainous regions such as Lao Cai, Lai Chau, etc., have been cultivated for generations, exhibiting strong adaptability to diverse agroecological environments (Toàn et al., 2021). These traditional varieties are notable for their unique genetic characteristics, such as high amylopectin content and distinct flavor profiles, and they contribute significantly to food security and the preservation of cultural heritage.

There is wide genetic diversity in waxy maize for agronomic traits such as plant height, maturity, economic characters, resistance to insects and diseases, and yield components in those regions. Understanding the genetic diversity, nutritional composition, and agronomic performance of these landraces is essential for their conservation and potential use in breeding programs aimed at enhancing resilience and productivity (Luo et al., 2020; Zheng et al., 2013). Currently, many waxy maize varieties are being conserved to maintain genetic resources at the Vietnam Maize Research Institute and the Plant Resources Centre. However, they have not yet been systematically described or evaluated in detail regarding their morphological traits, yield potential, and quality characteristics.

DNA markers provide estimates of genotypic variation that differ from morphological and pedigree-based information, offering more reliable, direct, and effective tools for germplasm management and conservation. Simple Sequence Repeat (SSR) markers, also known as microsatellites, are extensively used in plant genetic research because of their high level of polymorphism, co-dominant inheritance, and reliable reproducibility (Yin et al., 2023). The application of SSR markers has proven to be a powerful tool for assessing genetic diversity, population structure, and phylogenetic relationships among plant species (Vu et al., 2015; Zhang et al., 2023; Zhu et al., 2023). By analyzing the variation in SSR loci, researchers can gain valuable insights into the genetic makeup of different maize genotypes, which supports conservation efforts, breeding programs, and the management of genetic resources (Islam et al., 2023; Sa et al., 2024).

Advances in molecular biology have greatly complemented traditional breeding methods, significantly aiding the

identification of genetic polymorphisms within inbred line collections and enhancing their potential use in maize improvement. However, most of these studies have concentrated on flint maize germplasm, with limited research on waxy maize materials. This study, therefore, aims to assess the genetic polymorphism of a waxy maize inbred line collection using SSR markers, supporting the development of high-yielding, high-quality hybrid waxy maize varieties in Vietnam.

2. Materials and Methods

2.1 Plant Materials

The plant material used in this study consisted of leaf samples from 200 local waxy maize varieties collected from various provinces across Vietnam, including Bac Kan, Cao Bang, Ha Giang, Hoa Binh, Lai Chau, Son La, Yen Bai, Tuyen Quang, Dien Bien, Lang Son, the Northwestern region, Thanh Hoa, Quang Nam, Lam Dong, Khanh Hoa, Binh Phuoc, Kon Tum, Dak Lak, Dak Nong, among others, as well as from Laos, Cambodia, and Thailand (Supplement data sheet 1). These accessions are currently conserved at the Maize Research Institute and the Plant Resources Center.

2.2 SSR Analyses

Genomic DNA was extracted from leaves using the CTAB procedure (Matthes et al., 2020). The core 54 SSR markers were developed by AMBIONET, and can be downloaded from www.maizegdb.org (Hoxha et al., 2004; Kumar et al., 2012). PCR settings were following those reported by Islam et al. (2023). The core 54 SSR primers covered the entire maize genome (Supplement data sheet 2). The SSR PCR products were labeled with RedSafe fluorescent dyes, and the SSR DNA fragments were separated by Acryamide 4.5% for electrophoresis.

The binary format data ("1" and "0" indicate the presence and absence of alleles) was exported by PowerMarker V3.25 software (Liu & Muse, 2005). The polymorphism information content (PIC) and allele number for each marker were determined using PowerMarker V3.25 software. The genetic similarity coefficient was calculated by DARWIN version 6.0.021. Cluster analysis based on allele identity was carried out using PowerMarker V3.25 with the Neighbor-joining method (Liu & Muse, 2005). The Polymorphic Information Content (PIC) values were used to measure gene diversity (Anderson et al., 1993).

2.3 Phylogenetic Tree Construction

Neighbour-joining (NJ) phylogenies based on the Jaccard distance matrix were generated with DARWIN version 6.0.21 to reconstruct the gene tree from waxy gene data. One thousand bootstrap replicates were used to assess confidence in the phylogeny.

2.4 Analysis of Agronomic Traits Related to the Yield of Waxy Corn Varieties

Each variety was arranged in a randomized complete block design (RCBD) with three replications. The plot size for each experimental unit was 14 m² (5 × 2.8 m), in accordance with the Vietnamese Standard (TCVN 13381-2:2021). A minimum distance of 1 m was maintained between replications. Varieties were sown continuously, with four rows per plot. For data collection, 10 individual plants were measured in each experimental plot for each variety. The monitoring indicators (Plant height, P1000, growing duration, Ear length, Ear diameter, and Number of Kernel rows) and methods for monitoring, comparison, and testing of maize varieties follow the IBPGR/CIMMYT (1991) guidelines for the management of care and the collection of maize testing data.

3. Results

3.1 SSR Analyses of Vietnamese Waxy Maize

A set of 200 varieties of Vietnamese waxy maize, including typical landraces and inbred lines, was selected and analysed for genetic diversity using SSR markers. DNA was extracted employing a modified CTAB procedure. We used the set of 54 SSR markers downloaded from MaizeGDB (<http://www.maizegdb.org>), two from each chromosome (Supplement data sheet 1). PCR conditions and protocols were according to Islam et al. (2023). SSRs were multiplexed to maximise efficiency. Fragments were separated using capillary gels run. The PIC for each marker was determined as described by Anderson et al. (1993).

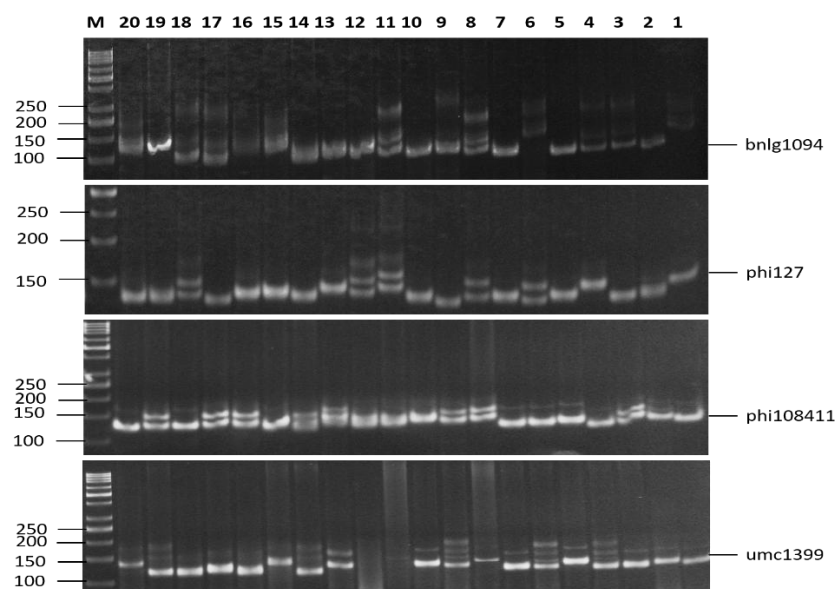


Figure 1: Electrophoresis of PCR Product of SSR Regions (bnlg 1094, phi 127, phi108411, umc1399). M: DNA ladder GeneRuler 50 bp (Thermofisher), 1-20: PCR product of waxy maize variety 1-20

Results from the analysis of 54 SSR primer pairs on 200 waxy maize samples revealed that 21 primer pairs showed polymorphism, including: nc133, phi029, phi112, phi127, phi102228, phi108411, phi374118, phi448880, phi452693, phi083, phi084, phi065, umc1136, umc1399, umc1021, umc1515, umc1630, umc1782, umc1357, bnlgl1094, and bnlgl1953 (Table 1).

Analysis of these 21 polymorphic SSR primer pairs yielded 104 alleles, with an average of 4.95 alleles per primer. The Polymorphism Information Content (PIC) values of the 21 primers ranged from 0.18 (phi112 – 3 alleles) to a maximum of 0.76 (umc1136 – 7 alleles). The average PIC value of the 21 primers analyzed was 0.55. Based on the genetic distance matrix of 200 waxy maize samples/varieties, the results indicate high genetic diversity among the studied accessions. The genetic distance ranged from as low as 0.03 (corresponding to a genetic similarity coefficient, GS, of 0.97) between closely related lines such as Pooc Cu Plau (62) and Pooc Cu Plau (63); White stone Bac Ei 3 (123) and White stone Bac Ei 4 (124); and White waxy Cao Bang 1 (164) and White waxy Cao Bang 2 (165), to as high as 0.77 (GS = 0.23) between two genetically distant lines: Corn Cham deng (Brown) (31) and Lien Son waxy (84) (Data not shown).

Table 1: List of 21 SSR Primers Showed the Polymorphism

No.	Oligo name	Chroma.	No. Allele Detected	PIC Value
1	nc133	2.05	4	0.32
2	phi029	3.04	4	0.36
3	phi112	1.01	3	0.18
4	phi127	2.08	5	0.49
5	phi102228	3.04	4	0.54
6	phi108411	9.06	5	0.58
7	phi374118	3.02	4	0.54
8	Phi448880	9.05	6	0.74
9	Phi452693	6.06	5	0.67
10	Phi083	2.04	7	0.42
11	Phi084	10.04	3	0.55
12	umc1399	3.07	6	0.70
13	umc1136	3.10	7	0.76
14	bnlg1094	2.00	7	0.72
15	bnlg1953	9.00	3	0.38
16	phi065	9.03	5	0.57
17	umc1021	2	4	0.48
18	umc1515	3	4	0.33
19	umc1630	6	6	0.75
20	umc1782	7	5	0.74
21	umc1357	5	7	0.69
	Total		104	
	Average		4.95	0.55

3.2 Phylogenetic Analysis

Neighbour-joining (NJ) phylogenies based on the Jaccard distance matrix were generated using Darwin version 6.0.021 to reconstruct the gene tree from waxy gene data. One thousand bootstrap replicates were used to assess confidence in the phylogeny. Based on the phylogenetic dendrogram, the 200 maize varieties could be classified into six groups (Figure 2). Based on genetic distance among varieties, the collected Vietnamese waxy maize can be divided into 6 subgroups.

Group I consisted of 65 samples/varieties, further divided into five subgroups. Among them, samples 123 (White stone Bac Ei 3) and 124 (White stone Bac Ei 4) exhibited the highest genetic similarity of 97%. Group II included 16 samples/varieties, with samples 137 (Golden waxy Phieng Pang 1) and 138 (Golden waxy Phieng Pang 2) showing the highest genetic similarity within this group at 96%. In contrast, samples 152 (White waxy Chieng Khay) and 166 (Without ear waxy maize) had the lowest genetic similarity at 43%. Group III comprised 19 samples/varieties. The pair 19 (Campuchia 1 Waxy Maize) and 20 (Campuchia 2 Waxy Maize) had the highest genetic similarity within the group at 95%. This group also included the White Waxy varieties from Laos (22), suggesting their close proximity. Group IV included 33 samples/varieties, divided into two subgroups. Samples 164 (Cao Bang 1 White waxy) and 165 (Cao Bang 2 White waxy) showed the highest genetic similarity at 97%. Group V consisted of 31 varieties, also divided into two subgroups. Samples 62 (Pooc Cu Plau – white waxy maize collected in Na Hoi, Bac Ha, Lao Cai) and 63 (Pooc Cu Plau – white waxy maize collected in Nam Mon, Bac Ha, Lao Cai) exhibited the highest genetic similarity of 97%. Group VI comprised 36 samples/varieties, divided into three subgroups. Samples 100 (White maize) and 101 (Ba Ta Ra) had the highest genetic similarity within the group at 84%.

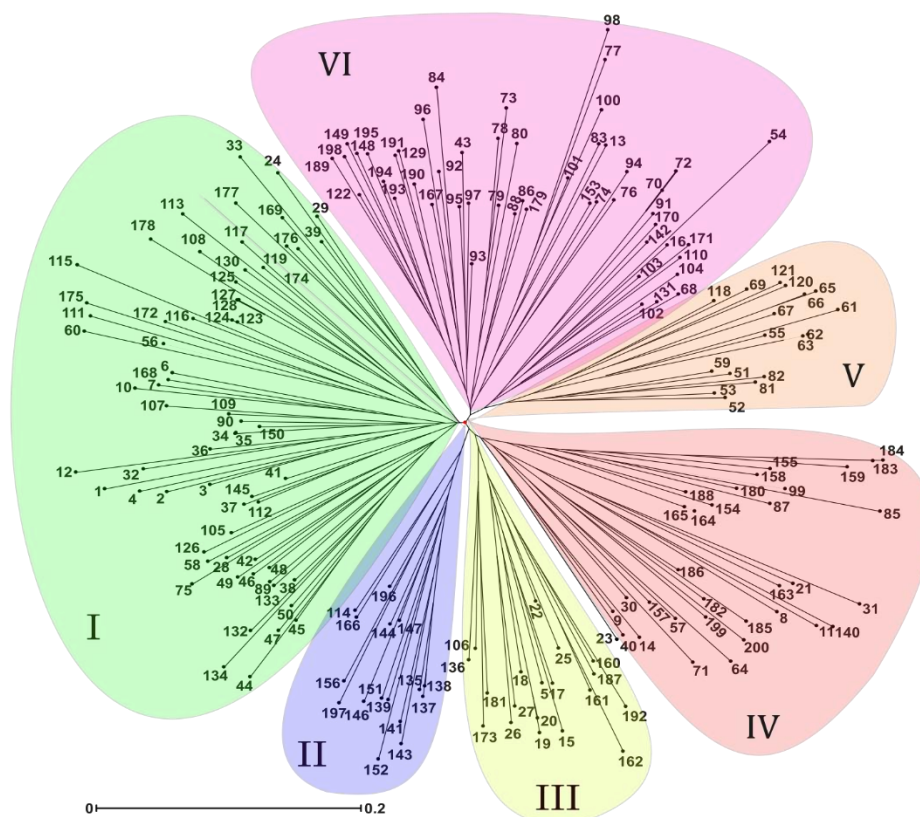


Figure 2: Histogram Indicates the Distribution of Plant Height of 200 Waxy Maize Varieties

3.3 Morphology Traits Related to the Yield Performance Analysis

Yield-related agronomic traits such as plant height, growth duration, ear length, ear diameter, and 1000-kernel weight (P1000) were recorded for individuals of the studied waxy maize varieties (Supplement data sheet 3). Differences in trait values among groups were analyzed using ANOVA at a significance level of 0.05. The results showed that Group I had the highest average plant height (188 cm), which was significantly taller than those of Group III (180 cm) and Group VI (166 cm). Yield-related ear traits showed considerable variation among the waxy maize varieties studied. Ear length ranged from

5.5 cm, recorded in variety 162 (Nep trang Pa Tan I, Lai Chau), to 17.4 cm in variety 75 (To Tich, Gia Lai). Similarly, ear diameter varied substantially, ranging from 2.3 cm in variety 162 (Nep trang Pa Tan I, Lai Chau) to 4.8 cm in variety 70 (Tor 2, Gia Lai). In addition, Group I also had the longest average ear length (12.4 cm), significantly longer than Group II (9.72 cm), which recorded the shortest ear length. The ear diameter of Group I (4.0 cm) was comparable to that of Group V (3.9 cm) and markedly greater than that of Group II (3.5 cm). No significant differences were observed among the six waxy maize groups in terms of growth duration (ranging from 58 to 75 days), 1000-kernel weight (P1000), and average number of kernel row per ear (Figure 3).

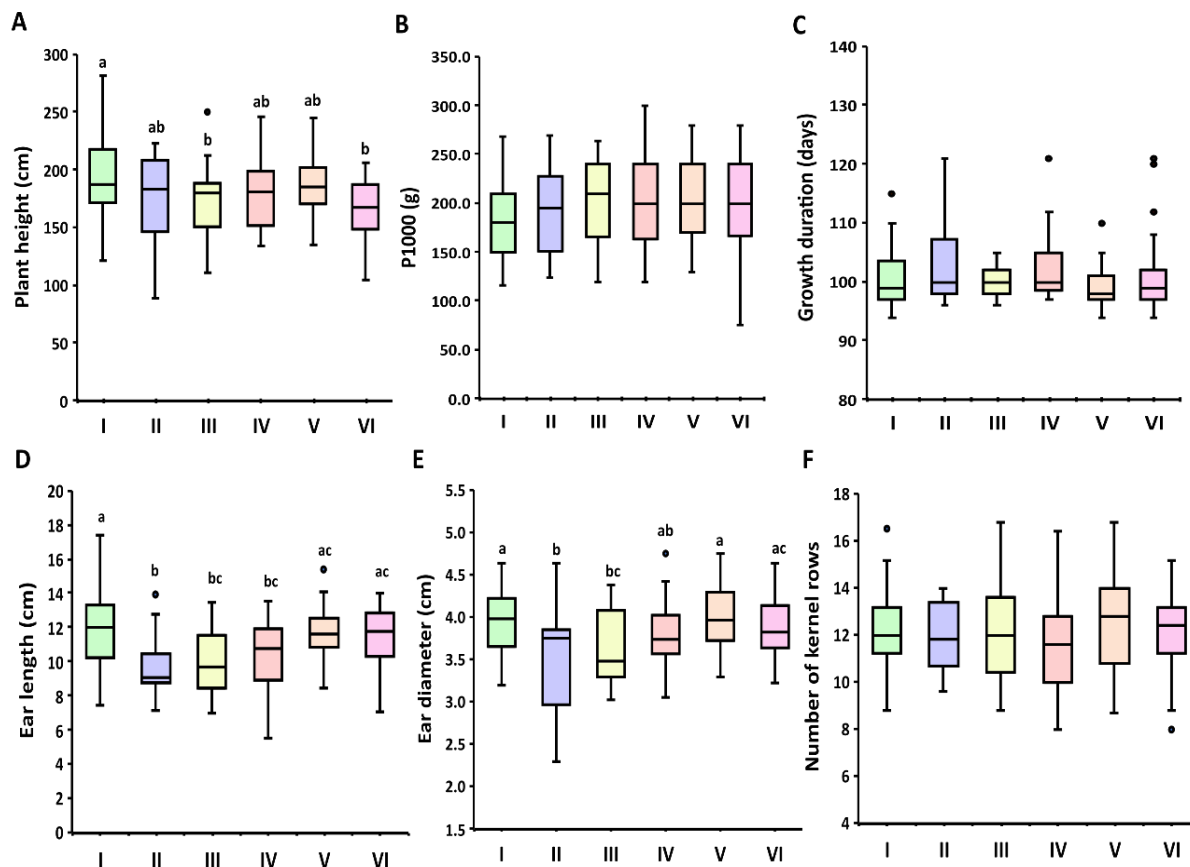


Figure 3: Comparison of the agronomic traits between 6 genetic groups. The box plots indicate A. Plant height; B. Weight of 1000 seeds (P1000); C. Growth duration; D. Ear length; E. Ear diameter; F. Number of rows per ear of the 6 groups of Vietnamese waxy maize. Different letters above the graph bar designate statistically significant differences according to two-way ANOVA using Tukey's HSD test with $p < 0.05$.

4. Discussion

Waxy maize is believed to have originated in China and was introduced and widely propagated approximately 400 years ago (Xiao-yang et al., 2022). The waxy phenotype arises from mutations that impair amylase synthesis, resulting in starch composed of nearly 100% amylopectin (Sa et al., 2024). To investigate the genetic diversity of Vietnamese waxy maize, we included representative landraces and inbred lines commonly used in current local production and some Southeast Asian nations.

The SSR markers with proven performance for maize genotyping were selected to analyze 200 waxy maize varieties. The genetic diversity observed in the waxy maize germplasm of this study, as indicated by an average of 4.95 alleles per SSR marker, a total of 104 alleles, and an average PIC value of 0.55, reflects a moderate level of polymorphism. When compared with other studies, these results fall within a similar range. For example, a study on 165 Chinese waxy maize inbred lines reported a lower average of the PIC values for the 20 SSR loci ranged from 0.41 to 0.84, with an average of 0.70 (Zheng et al., 2013).

In contrast, Sa et al (2010) used 50 SSR markers to analyze genetic diversity and relationships among 84 waxy maize inbred lines in Korea. A total of 269 alleles were identified, with an average of 5.38 alleles per locus. The genetic diversity index ranged from 0.38 to 0.92, suggesting that Waxy maize inbred lines of Korean origin are more diverse than those of

Chinese origin (Sa et al., 2010). These comparisons underscore the moderate yet valuable genetic variability present in Vietnamese waxy maize germplasm, which holds potential for future breeding and conservation efforts.

In this study, the evaluation of agro-morphological characteristics of the studied waxy maize varieties was integrated to identify and select promising initial genetic materials for future waxy maize breeding efforts. Given the growing demand for waxy maize for use as food and breeding material, the identification of its genetic diversity has become increasingly vital. These results highlight the morphological diversity present in local waxy maize germplasm, which may provide valuable material for future breeding programs targeting yield improvement.

5. Acknowledgements

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6. References

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Supplement Data Sheet 1

No.	Code	Name of Cultivar	Kernel Spec.	Collecting Place
1	N1	White Stone Yen Thuy	White Stone	Yen Thuy, Hoa Binh
2	N2	White Stone Dac Min	White Stone	Dac Min, Dac Lac
3	N3	White Stone Kong Ana 1	White Stone	Krong Ana, Dac Lac
4	N4	White Stone Dac Nong 1	White Stone	Dac Nong
5	N5	White Stone Dong Van 1	White Stone	Dong Van, Ha Giang
6	N6	White Stone Tay Nguyen 1	White Stone	Tay Nguyen
7	N7	White Stone Na Vin	White Stone	Quang Ba, Ha Giang
8	N8	White Stone Quang Son 1	White Stone	Quang Son, Quang Ninh
9	N9	Nep vang trang MB	White Stone	Mien Bac
10	N10	Nep vang Mai Chau	Yellow Waxy	Mai Chau, Hoa Binh
11	N11	Nep vang Dong Van	Yellow Waxy	Dong Van, Ha Giang
12	N12	Nep vang Da Bac	Yellow Waxy	Doan ket, Da Bac, Hoa Binh
13	N13	Nep vang Nam Sooc	Yellow Waxy	Mau Due, Yen Minh, Ha Giang
14	N14	Purple Waxy Krong Nang	Purple Waxy	Krong Nang, Dac Lac
15	N15	Purple Waxy Xinh Phinh 1	NTD	Xinh Phinh, Tua Chua, Lai Chau
16	N16	Nep nau Pieng Ta	Red Waxy	Mai Hich, Mai Chau, Hoa Binh
17	N17	Purple Waxy Mai Chau	Purple Waxy	Mai Chau, Hoa Binh
18	N18	White Waxy Krong Ana	White Waxy	Krong Ana, Dac Lac
19	N19	White Waxy Camphuchia 1	White Waxy, hat rat nho	Camphuchia
20	N20	White Waxy Camphuchia 2	White Waxy	Camphuchia
21	N21	White Waxy Thailan	White Waxy	Thai Lan
22	N22	White Waxy Lao 1	White Waxy	Lao
23	N23	White Waxy Lung Trang 2	White Waxy, hat Dep	Thai hoc, Nguyen Binh, Cao Bang
24	N24	Purple Waxy Nha Trang	Purple Waxy	Nha Trang, Khanh Hoa
25	N25	Nep vang Bang Khoang	Yellow Waxy	Muong Gion, Quynh Nhai, Son La
26	N26	White Waxy Ta Tong	NTD	Ta Tong, Muong Te, Lai Chau
27	N27	Bap Cham Deng (Tim)	Purple Waxy nau	Nam Quang, Bao Lam, Cao Bang
28	N28	Bap Cham	White Waxy	Mong an, Bao Lam, Cao Bang
29	N29	Mu May Si	White Waxy	Mong an, Bao Lam, Cao Bang
30	N30	Bap Nua		Tien Thanh, Phuc Hoa, Cao Bang
31	N31	Bap Cham Deng (Nau)	Purple Waxy nau	Tien Thanh, Phuc Hoa, Cao Bang
32	N32	Hau Tay Siem	White Waxy	Duc Hanh, Bao Lam, Cao bang
33	N33	Me Be	White Waxy	Vinh Phong, Bao Lam, Cao Bang
34	N34	Nep Lao Cai 1	White Waxy	Son Thuy, Van Ban, Lao Cai
35	N35	Nep Lao Cai 2	White Waxy	Danh Thang, Van Ban, Lao Cai
36	N36	No Po Cu	White Waxy	Sa Long, Muong Cha, Dien Bien
37	N37	Cu Plau	White Waxy	Cao Tan, Pac Nam, Bac Can
38	N38	Bap Cu Chua	White Waxy	Nhan Mon, Pac Nam, Bac Can
39	N39	Pa Cu Dau	White Waxy	Na Phac, Ngan Son, Bac Can
40	N40	Ho Bo Coc	White Waxy	To Tung, Kbang, Gia Lai
41	N41	Abhoo	White Waxy	A Tieng, Tay Giang, Quang Nam
42	N42	AB hoo Dep Bhooc	White Waxy	A Xan, Tay Giang, Quang Nam
43	N43	Bung May Lat	White Waxy	Thanh Duc, Vi Xuyen, Ha Giang
44	N44	Bap Nua	White Waxy	Ngoc Minh, Vi Xuyen, Ha Giang
45	N45	Ko Me Put	White Waxy	Giap Trung, Bac Me, Ha Giang
46	N46	Bap Nu	White Waxy	Bac la, Van Lang, Lang Son
47	N47	Khau Tay Nu	White Waxy	Gia Mien, Van Lang, Lang Son
48	N48	Pooc Cu	White Waxy	Hop Thanh, Phu Luong, Thai Nguyen
49	N49	Ca Le	White Waxy (Purple Waxy + vang)	Mai Ha, Mai Chau, Hoa Binh
50	N50	Hu Nu	White Waxy	Py Lo, Hoang Su Phi, Ha Giang
51	N51	Tar	White Waxy	Ea Rbin, Lac, Dac Lac
52	N52	Bap Nu	White Waxy	Ea Rbin, Lac, Dac Lac
53	N53	Nep	White Waxy	Phuc ung, Son Duong, Tuyen Quang
54	N54	Pooc Cu Plau	White Waxy	Nam Mon, Bac Ha, Lao Cai
55	N55	Lo Po Cu	White Waxy + Tim	Muong Toong, Muong Nhe, Dien Bien
56	N56	To Bac Cu	White Waxy	Pho Bang, Dong Van, Ha Giang

57	N57	Khau Tay Nu	White Waxy	Gia Mien Van Lang, Lang Son
58	N58	Cuu Plau	White Waxy	Sung Tra, Meo Vac, Ha Giang
59	N59	White Waxy	White Waxy	Krong Jing, M' D rac, Dac Lac
60	N60	White Waxy Na Xac	NTD	Na Xac- Quang Hoa- Cao Bang
61	N61	Hu Lu	White Waxy	Na Hyi, Bac Ha, Lao Cai
62	N62	Pooc Cu Plau	White Waxy	Na Hyi, Bac Ha, Lao Cai
63	N63	Pooc Cu Plau	White Waxy	Nam Mon, Bac Ha, Lao Cai
64	N64	Pooc Cu Le	White Waxy	Ta Van, Quang Ba, Ha Giang
65	N65	Nep Van Ban 1	White Waxy	Son Thuy, Van Ban, Lao Cai
66	N66	Nep Van Ban 2	White Waxy	Liem Phu, Van Ban, Lao Cai
67	N67	Me Nhieu	White Waxy	Liem Phu, Van Ban, Lao Cai
68	N68	Bo trong	White Waxy	Ngo Tem, Kon Plong, Kon Tum
69	N69	Tor	Tim, hong nhát	La Non, Duc Co, Gia Lai
70	N70	Tor 2	White Waxy	La Non, Duc Co, Gia Lai
71	N71	Tor 3	Tim Den	La Kla, Duc Co, Gia Lai
72	N72	Tor 4	White Waxy	La Krel, Duc Co, Gia Lai
73	N73	White Waxy	White Waxy	Tu An, An Khe, Gia Lai
74	N74	To ro ry	White Waxy	Chu Don, Chu Phu, Gia Lai
75	N75	To Tich	White Waxy	Chu Don, Chu Phu, Gia Lai
76	N76	Tor Bau	Tim, nau nhát	La Hla, Chu Phu, Gia Lai
77	N77	Tor	Yellow Waxy	Aun ha, Phu Thien, Gia Lai
78	N78	Hbo Bpong	Tim, nau, vang, trang	Chu Thai, Phu Thien, Gia Lai
79	N79	Ho Bo	White Waxy	Chu Thai, Phu Thien, Gia Lai
80	N80	Nep Quang Ninh	White Waxy	Quang Lam, Dam Ha, Quang Ninh
81	N81	Khay Tay Nu	White Waxy	Mong an, Binh Gia, Lang Son
82	N82	Khau Thay Nu	White Waxy	Gia Mien, Van Lang, Lang Son
83	N83	Bap Nu	White Waxy	Lien Son, Tan Yen, Bac Giang
84	N84	Nep Lien Son	White Waxy	Lien Son, Tan Yen, Bac Giang
85	N85	Nep Vo Nhai	White Waxy	Than Xa, Vo Nhai, Thai Nguyen
86	N86	Bap Gao	White Waxy	Lyc Bac, Bao Lam, Lam Dong
87	N87	Me Pe	White Waxy	Ky Thuong, Hoanh Bo, Quang Ninh
88	N88	C	White Waxy	Tien Phong, Quang Yen, Quang Ninh
89	N89	Dang Pieu	White Waxy	Bac Lang, Dinh Lap, Lang Son
90	N90	Mac No	White Waxy	Chau Son, Dinh Lap, Lang Son
91	N91	Khau tay bao	White Waxy	Dong Buc, Loc Binh, Lang Son
92	N92	Dung May	White Waxy	Ban Luyc, Hoang Su Phi, Ha Giang
93	N93	Play Popa ro	White Waxy	Bu Dang, Binh Phuoc
94	N94	Ca To	Yellow Waxy	Ea Hleo, Dac Lac
95	N95	Purple Waxy	Tim nau	Ea Hleo, Dac Lac
96	N96	Put Nap	White Waxy	Tan Tien, Bu Dyp, Binh Phuoc
97	N97	Purple Waxy	White Waxy-tim	Bu Gia Map, Binh Phuoc
98	N98	Bo	White Waxy	Bu Gia Map, Binh Phuoc
99	N99	Nep Son Duong	White Waxy	Khang Nhat, Son Duong, Tuyen Quang
100	N100	Bap trang	Trang, tim	Hoa Dong, Krong Pac, Dac Lac
101	N101	Ba Ta Ra	White Waxy	Hoa Dong, Krong Pac, Dac Lac
102	N102	Purple Waxy	White Waxy	Nam D nia, Krong No, Dac Nong
103	N103	Nep vang Noong Heo	Nep Vang-LT	Noong Heo, Sin Ho, Lai Chau
104	N104	Bap trang	White Waxy	Ea Huar, Buon Don, Dac Lac
105	N105	Mo M'ham	Purple Waxy	Dac Phoi, Lac, Dac Lac
106	N106	Nep	White Waxy (co tim Da nhát loại)	Minh Thanh, Son Dong, Tuyen Quang
107	N107	A Bo Dep	White Waxy	Tay Giang, Quang Nam
108	N108	Me But	White Waxy	Dong Son, Hoanh Bo, Quang Ninh
109	N109	A Loi Do Do	White Waxy, tim	Dac Pne, Kon Ray, Kon Tum
110	N110	Mai Mai	White Waxy	Kim Thuong, Tan Son, Phu Tho
111	N111	White Waxy Muong Khuong	White Waxy	Cao Son, Muong Khuong, Lao cai
112	N112	White Waxy Khau Pum	NTD-LT	Chieng Khay, Quynh Nhai, Son La
113	N113	White Waxy Lao Ha	White Waxy	Co Ma, Thuan Chau, Son La
114	N114	Nep vang Tuc Dan	Nep vang, trang	Tuc Dan, Tram Tau, Yen Bai
115	N115	White Waxy Phinh Ho	White Waxy	Phinh Ho, Tram Tau, Yen Bai
116	N116	White Waxy Le Loi 2	White Waxy	Le Loi, Sin Ho, Lai Chau
117	N117	Purple Waxy Chan Nua	White Waxy	Chan Nua, Sin Ho , Lai Chau

118	N118	Ro nep	White Waxy	Lac Thinh, Yen Thuy, Hoa Binh
119	N119	Ngo nep	White Waxy	Son Thuy, Van Ban, Lao Cai
120	N120	Ro nep	White Waxy	Ngoc Son, Lac Son, Hoa Binh
121	N121	Trang Ba Lang		
122	N122	White Stone Quang Hoa		
123	N123	White Stone Bac ai 3		
124	N124	White Stone Bac ai 4		
125	N125	White Stone Krong Pach		
126	N126	V-X-2-1 (4)		
127	N127	White Stone Dac Lac 1		
128	N128	White Stone Dac Lac 2		
129	N129	Ngo Diem Dac Lac		
130	N130	White Stone Tay Nguyen 1		
131	N131	White Stone Nha Trang		
132	N132	White Waxy Phong Du		
133	N133	White Waxy Quang Son		
134	N134	White Waxy Dien Xa		
135	N135	Nep vang Chieng Chan	Yellow Waxy	Chieng Chan, Mai Son, Son La
136	N136	Nep vang Chieng Noi	Yellow Waxy	Chieng Noi, Mai Son, Son La
137	N137	Nep vang Phieng Pang 1	Yellow Waxy	Phieng Pan, Mai Son, Son La
138	N138	Nep vang Phieng Pang 2	Yellow Waxy	Phieng Pan, Mai Son, Son La
139	N139	Nep vang Chieng Kheo	Yellow Waxy	Chieng Kheo, Mai Son, Son La
140	N140	Nep vang Chieng Ve	Yellow Waxy	Chieng Ve, Mai Son, Son La
141	N141	Nep vang Pho I	Yellow Waxy	Pho I, Pa Tan, Sin Ho, Lai Chau
142	N142	Nep vang Nam Nga	Yellow Waxy	Nam Nga, Can Co, Sin Ho, Lai Chau
143	N143	White Waxy Thai Son	NTD	Thai Son, Ham Yen, Tuyen Quang
144	N144	Purple Waxy it Ta Bot	Red Waxy	it Ta Bot, Chieng Khay, Quynh Nhai, Son La
145	N145	Purple Waxy Nam Cha	Purple Waxy	Nam Cha, Sin Ho, Lai Chau
146	N146	Purple Waxy Nam Cha I	Purple Waxy	Nam Cha I, Nam Cha, Sin Ho, Lai Chau
147	N147	Purple Waxy Le Loi	Purple Waxy loang	Le Loi, Sin Ho, Lai Chau
148	N148	White Waxy Lang Trang	NTD	Lang Trang, Chiem Hoa, Tuyen Quang
149	N149	White Waxy Tan Lap	NTD	Tan Lap, Moc Chau Son La
150	N150	White Waxy Xe Trong	1/2NTD	Xe Trong, Chieng on, Quynh Nhai, Son La
151	N151	White Waxy it Ta Bot	NTD	it Ta Bot, Chieng Khay, Quynh Nhai, Son La
152	N152	White Waxy Chieng Khay	NTD	Chieng Khay, Quynh Nhai, Son La
153	N153	White Waxy Ban Cu	NTD	Ban Cu, Chieng Ly, Thuan Chau, Son La
154	N154	White Waxy Pa Lang	NTD	Pa Lang, Na Hang, Tuyen Quang
155	N155	White Waxy Chieng Chan	NTD	Chieng Chan, Mai Son, Son La
156	N156	White Waxy Chieng Kheo	NTD	Chieng Kheo, Mai Son, Son La
157	N157	White Waxy Chieng Mung	NTD	Chieng Mung, Mai Son, Son La
158	N158	White Waxy Phang Xo Lin II	NTD	Phang So Lin, Sin Ho, Lai Chau
159	N159	White Waxy Cuoi Nua	NTD	Cuoi Nua, Nam Cuoi, Sin Ho, Lai Chau
160	N160	White Waxy Chat Dao	NTD	Chat Dao, Nam Han, Sin Ho, Lai Chau
161	N161	White Waxy Hong Ngai	NTD	Hong Ngai, Nam Cha, Sin Ho, Lai Chau
162	N162	White Waxy Pa Tan I	White Waxy	Pa Tan I, Pa Tan, Sin Ho, Lai Chau
163	N163	White Waxy Xom Lang	NT	Xom Lang, Yen Hoa, Da Bac, Hoa Binh
164	N164	White Waxy Cao Bang 1	NTD	Cao Bang
165	N165	White Waxy Cao Bang 2	NTD	Cao Bang
166	N166	Nep khong tai la	White Waxy, hat nho	Phu Thuong, Vo Nhai, Thai Nguyen
167	N167	White Waxy Na Trang	NTD	Na Trang, Chiem Hoa, Tuyen Quang
168	N168	Nep Do Thai	N Do	Thai Lan
169	N169	Nep Tay Bac 1	NTD	Tay Bac
170	N170	Purple Waxy Lung Chang	Purple Waxy	Lung Chang, Nguyen Binh, Cao Bang
171	N171	White Waxy Na Mo	NTD	Na Mo, Chiem Hoa, Tuyen Quang
172	N172	White Waxy Na Thoi 1	NTD	Na Thoi, Chiem Hoa, Tuyen Quang
173	N173	Nep Lao 2	Purple Waxy	Lao
174	N174	Nep vang Ban Mu	Yellow Waxy	Ban Mu, Tram Tau, Yen Bai
175	N175	White Waxy Lung Chang 1	NTD	Lung Chang, Nguyen Binh, Cao Bang
176	N176	White Waxy Thon Bua	NTD	Thon Bua, Trung Thanh, Da Bac, Hoa Binh
177	N177	Purple Waxy Na Lung	NTD	Na Lung, Ca Thanh, Nguyen Binh, Cao Bang

178	N178	White Waxy Xom Ghe	NTD	Xom Ghe, Xoan Mai, Mai Chau, Hoa Binh
179	N179	Nep xa Bac Kan	NTD	Thanh Hoa
180	N180	White Waxy Tong Nga	NTD	Tong Nga, The Duc, Nguyen Binh, Cao Bang
181	N181	White Waxy Tong Say	NTD	Tong Say, Nguyen Binh, Cao Bang
182	N182	White Waxy Doc Mon	NTD	Doc Mon, Yen Son, Thanh Nong, Cao Bang
183	N183	White Waxy Tap Na 1	NTD	Tap Na, Thong Nong, Cao Bang
184	N184	White Waxy Tap Na 2	NTD	Tap Na, Thong Nong, Cao Bang
185	N185	Nep Meo Vac	NTD - Lhong	Meo Vac, Ha Giang
186	N186	White Waxy Cyc Cuoi	NTD	Cyc Cuoi, Da Thong, Thong Nong, Cao Bang
187	N187	White Waxy Khuoi Lieng	NTD	Khuoi Lieng, Van Minh, Na Ri, Bac Kan
188	N188	White Waxy Lung Can	NTD	Lung Can, Kim Hy, Na Ri, Bac Kan
189	N189	White Waxy Khuoi Nan	NTD	Khuoi Nan, Luong Ha, Na Ri, Bac Kan
190	N190	White Waxy Ban Nua	NTD	Ban Nua, Nhu Cy, Cho Moi, Cao Bang
191	N191	White Waxy Thong Than	NTD	Thong Than, Cai Bo, Quang Uyen, Cao Bang
192	N192	White Waxy Pac Tan	NTD	Pac Tan, Doai Khon, Quang Uyen, Cao Bang
193	N193	White Waxy Cyc Thuyt	NTD	Cyc Thuyt, Quang Uyen, Cao Bang
194	N194	White Waxy An Ma	NTD	An Ma, Chi Thao, Quang Uyen, Cao Bang
195	N195	White Waxy Pac Tham	NTD	Pac Tham, Vu Loan, Na Ri, Bac Kan
196	N196	White Waxy Hom Hoi	NTD	Hom Hoi, Ban Lam, Thuan Chau, Son la
197	N197	White Waxy Hat Lot, Son La	NTD	Hat Lot, Mai Son, Son la
198	N198	White Waxy De Ga 1	NTD	De ga, Thong Nong, Cao bang
199	N199	White Waxy Ban Ven	NTD	Ban Ven, Kim Hi, Na Ry, Bac Kan
200	N200	Nep Nga Son	NTD	Nga Son, Thanh Hoa

Supplement Data Sheet 2

No.	Primers	Sequence (5'-3')	No.	Primers	Sequence (5'-3')
1	nc133	F: AATCAAACACACACCTTGCG R: GCAAGGGAATAAGGTGACGA	28	phi448880	F: CGATCCGGAGGAGTTCCTTA R: CCATGAACATGCCAATGC
2	phi029	F: TTGTCTTTCTTCTCCACAAGCAGCGAA R: ATTTCCAGTTGCCACCGACGAAGAAGCTT	29	phi452693	F: CAAGTGCTCCGAGATCTTCCA R: CGCGAACATATTCAGAAGTTTG
3	phi032	F: CTCCAGCAAGTGATGCGTGAC R: GACACCCGGATCAATGATGGAAC	30	phi96100	F: AGGAGGACCCCAACTCCTG R: TTGCACGAGCCATCGTAT
4	phi041	F: TTGGCTCCAGCGCCGCAAA R: GATCCAGAGCGATTTGACGGCA	31	umc1109	F: GCAACACAGGACCAATCATCTCT R: GTTCGGTCCGTAGAGAAGTCTCA
5	phi053	F: CTGCTCTCAGATTCAGAGATTGAC R: AACCACCGTACTCCGGCAG	32	umc1136	F: CTCTCGTCTCATACCTTTCCCT R: CTGCATACAGACATCCAACCAAG
6	phi062	F: CCAACCCGCTAGGCTACTTCAA R: ATGCCATGCGTTCGCTCTGTATC	33	umc1153	F: CAGCATCTATAGCTTGCTTGCAAT R: TGGGTTTGTGTTGTTGTTGTTG
7	phi063	F: GGCGGCGGTGCTGGTAG R: CAGCTAGCCGCTAGATATACGCT	34	umc1161	F: GGTACCGCTACTGCTTGTACTGC R: GCTCGCTGTTGGTAGCAAGTTTTA
8	phi065	F: AGGGACAAATACGTGGAGACACAG R: CGATCTGCACAAAGTGGAGTAGTC	35	umc1279	F: GATGAGCTTGACGACGCTG R: CAATCCAATCCGTTGACAGGTC
9	phi072	F: ACCGTGCATGATTAATTTCTCCAGCCTT R: GACAGCGCGCAAATGGATTGAAT	36	umc1304	F: CATGCAGCTCTCCAAATTAATCC R: GCCAATAGAACTACTGCTGCTCC
10	phi078	F: CAGCACCAGACTACATGACGTGTAA R: GGGCCGCGAGTGATGTGAGT	37	umc1399	F: GCTCTGCTTATTCTTCAATCGGGC R: GGTCCGTCGGTACTCTGCTCTA
11	phi083	F: CAAACATCAGCCAGAGACAAGGAC R: ATTCATCGACGCGTCACAGTCTACT	38	umc1021	F: AGCCTCCTGAGACCTCTCGATT R: ACTTCGCCACCTTACATTCTTGA
12	phi084	F: AGAAGGAATCCGATCCATCCAAGC R: CACCCGTACTTGAGGAAAACCC	39	umc1515	F: AGAGAGGCTGCTTCAATAAGTTGC R: TTAGTAGTTTCGGTGTCCGTTTCC
13	phi087	F: GAGAGGAGGTGTTGTTTGACACAC R: ACAACCGGACAAGTCAGCAGATTG	40	umc1630	F: CAGACCTTCGAGGGCAAGAAT R: AGTTTTGGCTTCTTCTCCCAAGTC
14	phi093	F: AGTGCGTCAGCTTCATCGCCTACAAG R: AGGCCATGCATGCTTGCAACAATGGATACA	41	umc1246	F: TCGAGTTTGCTTCTCTCCAGTTTC R: TGCAGCATATGGCTCTTTATTCAA
15	phi1122	F: TGCCCTGCAGGTTACATTGAGT R: AGGAGTACGCTTGATGCTCTTC	42	umc1357	F: TAGACATGTTGAAACCAGGACCG R: ACGAGCTCAACAACAGCATGA
16	phi114	F: CCGAGACCGTCAAGACCATCAA R: AGCTCCAAACGATTCTGAATCGC	43	umc1782	F: TCGCATACCATGATCACTAGCTTC R: CGTCAACTACCTGGCGAAGAA
17	phi127	F: ATATGCATTGCTGGAACTGGAAGGA R: AATTCAAACACGCCTCCGAGTGT	44	phi065	F: AGGGACAAATACGTGGAGACACAG R: CGATCTGCACAAAGTGGAGTAGTC
18	phi100175	F: TATCTGACGAATCCCATTCCC R: GTACGTAACGGACGGACGG	45	phi115	F: GCTCCGTGTTTCGCTGAA R: ACCATCACCTGAATCCATCACA
19	phi101049	F: CCGGGAACCTGTTCATCG	46	bnlg1017	F: ATTGGAAGGATCTGCGTGAC

20	phi102228	R:CCACGTCCATGATCACACC F: ATTCCGACGCAATCAACA	47	bnlg 1346	R: CAGCTGGTGGACTGCATCTA F: CATCATGAAGCAATGAAGCC
21	phi108411	R: TTCATCTCCTCCAGGAGCCTT F: CGTCCCTTGGATTTCGAC	48	bnlg339	R: CCGCGCCATTATCTAGTTGT F: CCAACCGTATCAGCATCAGC
22	phi109188	R: CGTACGGGACCTGTCAACAA F: AAGCTCAGAAGCCGGAGC	49	bnlg 1588	R: GCAGAGCTCTCATCGTCTTCTT F: TAACCTGTTGTGCAGAGAGAGAG
23	phi227562	R: GGTCATCAAGCTCTGTGATCG F: TGATAAAGCTCAGCCACAAGG	50	bnlg 105	R: CCCAGAAACATCGCCAATG F: GACCGCCCGGGACTGTAAGT
24	phi233376	R: ATCTCGGCTACGGCCAGA F: CCGGCAGTCGATTACTCC	51	bnlg1094	R: AGGAAAGAAGGTGACGCGCTTTTC F: GTGAAGAACGATGACGCAGA
25	phi308707	R: CGAGACCAAGAGAACCCTCA F: GCAACAAGATCCAGCCGAT	52	bnlg127	R: CAGCAACGCTCTCACATTGT F: CATGTATACGAGAAGCACCTAT
26	phi374118	R: GTCGCCCTCATATGACCTTC F: TACCCGGACATGGTTGAGC	53	bnlg1287	R: ATCGTAACCTCAGCGGTTTGTG F: GCCCTACCTGTTCTGTCTCG
27	phi423796	R: TGAAGGGTGTCTTCCGAT F: CACTACTCGATCTGAACCACCA	54	bnlg155	R: TGTCCCATACCTCAACGTGA F: ACCGAGTAGCCGAGACACG
		R: CGCTCTGTGAATTTGCTAGCTC			R: AGAGTCCTGGAGCCACATGAG

Supplement Data Sheet 3

No.	Code	Height (cm)	P1000 (gram)	Grow Duration (days)	Ear Length (cm)	Ear Diameter (cm)	No. Kernel Rows
1	N1	172.0	150	97	10.94	3.94	13.2
2	N2	184.4	268	99	11.50	4.50	13.2
3	N3	178.0	140	97	10.32	4.48	13.2
4	N4	177.2	220	97	10.34	3.86	14.0
5	N5	189.0	190	100	13.50	3.92	10.8
6	N6	183.0	200	103	14.34	4.34	12.0
7	N7	220.0	190	98	13.04	3.42	10.4
8	N8	246.0	200	110	12.18	3.62	10.4
9	N9	193.0	210	112	11.06	4.32	13.2
10	N10	138.4	250	98	7.98	3.64	11.6
11	N11	185.6	160	98	9.84	3.78	10.8
12	N12	193.0	180	99	10.90	3.98	12.4
13	N13	198.6	280	112	9.92	3.78	10.8
14	N14	181.0	200	98	11.58	4.42	14.0
15	N15	188.8	204	105	9.62	3.40	9.2
16	N16	168.4	180	99	11.08	4.60	16.8
17	N17	199.0	200	98	11.18	3.92	13.6
18	N18	154.0	140	102	9.72	4.10	16.8
19	N19	117.8	120	96	8.70	4.08	16.4
20	N20	111.4	220	97	6.98	3.34	15.2
21	N21	142.4	120	97	11.08	3.54	14.8
22	N22	136.0	150	97	9.03	3.03	10.0
23	N23	162.6	156	99	10.52	3.66	8.8
24	N24	165.0	136	100	10.40	4.23	16.5
25	N25	180.4	220	99	11.58	3.92	12.8
26	N26	250.4	160	102	11.95	3.25	11.0
27	N27	210.0	240	105	10.72	4.38	12.0
28	N28	263.6	124	99	12.48	4.38	11.6
29	N29	282.0	180	115	9.50	3.80	12.0
30	N30	134.4	260	102	8.34	3.64	11.6
31	N31	235.0	124	99	13.04	4.76	12.8
32	N32	242.4	180	99	12.60	4.14	11.6
33	N33	254.8	230	105	12.90	4.33	12.0
34	N34	202.6	210	105	10.20	4.08	12.4
35	N35	200.0	140	99	10.30	3.58	10.4
36	N36	225.6	200	99	11.86	4.08	11.2
37	N37	200.0	160	102	11.68	4.00	12.8
38	N38	226.4	174	100	12.04	3.72	10.4
39	N39	218.0	230	105	14.78	4.40	11.6

40	N40	199.0	170	121	12.16	4.04	13.2
41	N41	190.0	230	97	9.36	3.66	12.0
42	N42	256.0	150	97	13.54	3.34	11.2
43	N43	188.6	190	100	13.16	3.92	11.2
44	N44	188.0	210	97	13.22	4.10	10.4
45	N45	186.0	200	96	10.34	3.94	12.0
46	N46	154.0	170	96	12.68	4.00	14.0
47	N47	184.0	240	96	11.46	3.60	12.4
48	N48	188.2	150	97	13.10	3.88	11.6
49	N49	195.0	240	97	9.74	4.28	14.0
50	N50	172.0	200	97	11.28	4.44	14.8
51	N51	189.6	200	96	13.26	4.64	13.6
52	N52	185.0	210	97	13.30	4.54	12.8
53	N53	201.4	144	98	11.52	3.78	11.6
54	N54	191.0	224	97	10.86	3.86	10.8
55	N55	209.6	280	98	10.35	3.98	11.0
56	N56	220.0	160	98	12.06	3.64	9.6
57	N57	159.0	220	102	10.24	3.76	12.4
58	N58	236.0	120	97	15.52	3.96	11.2
59	N59	157.6	216	105	8.50	4.04	12.4
60	N60	156.0	120	97	10.68	3.52	10.4
61	N61	192.4	250	99	11.18	3.54	10.8
62	N62	184.6	190	98	9.07	3.33	8.7
63	N63	205.0	240	101	10.58	3.80	10.4
64	N64	229.0	200	98	10.28	4.14	13.2
65	N65	206.0	144	98	11.56	4.04	14.0
66	N66	183.0	220	98	11.64	3.64	14.4
67	N67	184.4	240	98	12.07	3.75	12.0
68	N68	193.6	150	97	12.54	3.30	12.4
69	N69	164.0	200	99	10.98	4.34	13.2
70	N70	170.4	180	99	11.93	4.75	13.5
71	N71	200.0	240	105	11.90	3.80	11.6
72	N72	135.0	250	94	10.96	4.24	15.2
73	N73	104.9	270	94	10.80	4.19	11.8
74	N74	151.6	180	101	9.26	4.06	11.6
75	N75	256.0	140	101	17.42	4.28	13.2
76	N76	195.0	240	121	14.06	4.58	12.8
77	N77	163.0	160	97	10.96	4.22	12.4
78	N78	132.0	204	97	9.48	3.80	13.2
79	N79	146.0	130	98	11.98	4.40	13.2
80	N80	199.0	156	100	13.60	4.06	13.2
81	N81	144.4	276	96	10.46	3.56	14.0
82	N82	179.0	170	97	13.28	4.38	14.0
83	N83	150.4	244	94	12.72	4.30	14.8
84	N84	146.2	190	94	11.84	3.84	12.8
85	N85	207.6	196	97	12.16	3.74	12.6
86	N86	205.0	200	105	10.34	3.64	14.0
87	N87	198.8	150	105	13.58	4.00	10.4
88	N88	177.2	176	101	12.90	4.10	12.0
89	N89	218.4	180	107	13.80	3.96	11.6
90	N90	153.0	200	96	9.76	4.12	12.8
91	N91	202.0	280	96	11.68	3.72	10.4
92	N92	170.8	190	97	12.06	4.14	12.8
93	N93	144.6	220	97	10.14	4.64	13.6
94	N94	186.6	154	99	12.04	3.82	11.2
95	N95	150.7	240	120	7.07	3.23	8.0
96	N96	149.2	190	104	10.70	3.64	12.4
97	N97	204.0	150	108	12.02	3.84	12.8
98	N98	173.2	164	102	11.14	4.12	13.2
99	N99	194.0	140	97	11.32	3.78	11.6
100	N100	206.4	204	103	12.96	4.48	14.4

101	N101	177.4	204	99	13.72	4.16	15.2
102	N102	183.2	204	103	11.64	4.06	15.6
103	N103	150.8	240	110	10.00	4.18	15.5
104	N104	169.2	144	96	12.46	4.04	12.8
105	N105	160.0	210	103	13.30	4.10	12.8
106	N106	181.4	240	99	11.64	4.14	12.4
107	N107	259.6	140	104	14.62	3.64	12.8
108	N108	184.0	180	99	9.92	4.34	14.0
109	N109	200.0	230	101	11.08	3.44	13.2
110	N110	178.4	220	97	12.20	4.08	13.6
111	N111	178.4	200	97	12.08	4.56	12.0
112	N112	124.4	164	102	8.42	3.38	8.8
113	N113	206.2	160	105	13.92	4.28	12.4
114	N114	147.0	200	96	9.18	3.34	10.8
115	N115	215.4	200	104	12.54	4.08	12.0
116	N116	184.8	204	99	9.98	3.98	12.4
117	N117	216.6	140	105	12.06	3.72	12.4
118	N118	211.8	250	110	10.78	3.66	11.6
119	N119	168.2	260	101	10.78	4.00	13.6
120	N120	245.2	160	103	15.40	4.42	11.2
121	N121	189.6	180	99	14.12	4.30	14.0
122	N122	188.8	164	99	13.06	3.92	10.8
123	N123	122.0	170	94	9.00	3.48	10.4
124	N124	130.4	182	98	10.24	3.20	10.0
125	N125	166.2	174	100	14.40	4.64	12.8
126	N126	144.6	240	100	12.86	4.20	13.2
127	N127	177.0	200	99	12.92	3.80	10.4
128	N128	162.4	150	99	13.34	4.26	12.8
129	N129	169.6	250	98	12.54	4.08	12.8
130	N130	183.4	190	99	14.68	4.64	13.2
131	N131	176.0	130	100	13.50	3.82	10.4
132	N132	225.4	150	110	14.08	3.80	11.6
133	N133	226.8	116	110	13.32	3.58	10.4
134	N134	197.4	190	105	13.64	3.44	11.2
135	N135	189.0	194	100	8.90	3.44	10.8
136	N136	182.6	180	101	8.33	3.20	10.0
137	N137	143.4	160	98	8.98	2.83	10.0
138	N138	147.6	180	98	8.38	2.92	10.8
139	N139	188.2	270	98	8.80	4.08	13.6
140	N140	188.6	120	100	12.34	3.38	12.0
141	N141	223.4	230	108	8.27	2.53	10.7
142	N142	219.6	160	110	12.52	3.96	13.6
143	N143	140.8	196	98	8.74	3.74	12.8
144	N144	178.4	156	100	10.62	3.78	11.6
145	N145	251.8	170	110	13.82	4.24	14.0
146	N146	214.2	128	110	10.46	3.84	12.8
147	N147	216.2	250	105	12.80	3.12	9.6
148	N148	171.8	250	100	10.62	3.64	10.8
149	N149	194.8	200	105	13.90	3.66	11.2
150	N150	217.0	214	105	12.04	3.80	11.2
151	N151	215.0	124	121	13.96	3.84	12.0
152	N152	177.8	220	97	10.48	3.92	13.6
153	N153	132.8	214	98	9.96	3.62	14.0
154	N154	143.0	240	100	7.80	3.18	8.7
155	N155	157.6	230	100	7.72	3.06	12.8
156	N156	192.2	200	102	9.10	3.86	12.8
157	N157	201.8	200	107	8.97	3.17	11.5
158	N158	183.2	260	102	7.86	4.24	12.4
159	N159	209.2	170	107	12.78	4.00	12.0
160	N160	213.2	220	105	10.78	4.36	12.4

161	N161	162.6	210	101	10.90	3.22	10.8
162	N162	189.0	166	104	12.64	3.82	10.4
163	N163	145.2	170	112	5.50	3.55	9.5
164	N164	134.8	204	101	8.96	3.74	11.6
165	N165	152.8	250	101	10.78	3.98	10.8
166	N166	89.0	230	105	7.15	2.30	10.0
167	N167	121.4	220	96	8.22	3.54	8.8
168	N168	182.2	130	100	13.98	4.20	13.6
169	N169	165.4	250	101	9.26	3.92	11.2
170	N170	208.6	180	103	13.22	3.76	8.8
171	N171	188.0	200	98	11.14	3.46	10.4
172	N172	141.2	150	102	7.50	3.50	10.4
173	N173	151.0	264	100	7.92	3.48	11.2
174	N174	190.4	200	107	8.56	3.98	13.6
175	N175	188.8	124	107	14.02	4.14	12.4
176	N176	188.0	260	99	10.04	3.66	10.8
177	N177	173.2	220	99	9.92	4.06	12.4
178	N178	177.8	150	100	10.78	4.10	15.2
179	N179	166.0	170	102	10.56	3.80	12.8
180	N180	181.0	300	98	8.74	3.68	8.8
181	N181	176.8	250	98	8.58	3.30	8.8
182	N182	150.0	180	100	10.74	3.32	8.0
183	N183	163.4	240	98	8.70	3.60	8.7
184	N184	150.2	240	99	10.74	3.70	11.6
185	N185	174.8	240	102	9.72	4.24	14.4
186	N186	158.8	140	99	10.84	3.42	9.6
187	N187	140.8	240	99	8.48	3.44	14.0
188	N188	196.4	190	105	12.00	3.64	9.6
189	N189	162.2	200	98	12.72	3.64	12.4
190	N190	171.0	76	102	13.28	3.70	9.2
191	N191	123.6	224	96	9.70	3.26	12.0
192	N192	157.2	236	97	8.38	3.30	12.0
193	N193	172.6	140	97	12.78	3.62	8.8
194	N194	148.4	270	97	10.28	3.56	10.8
195	N195	166.6	256	97	10.62	3.62	13.6
196	N196	192.0	150	108	9.80	3.78	13.6
197	N197	178.0	144	99	9.00	4.63	14.0
198	N198	157.0	200	98	11.68	3.82	11.2
199	N199	156.2	168	100	11.02	3.58	10.4
200	N200	134.2	210	103	10.78	4.14	16.4