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Performance of Exotic Cucumber Varieties under Local Cultivation Practices in Kapilvastu District of Nepal

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Abstract— *A field experiment was carried out in the Western Terai of Nepal, Buddhabhumi municipality of Kapilvastu district to screen out the best-performing cucumber variety among the five most cultivated exotic varieties; LHC-1395, LHC-Maria, Dynasty, NS-408, and Rehmat-1080 during February to July of 2019. The package of cultivation practiced in this study replicates that of the local farmers. The experimental setup was laid on Randomized Complete Block Design having five replications and five treatments in an area of the 750-meter square. The crop geometry was maintained at 25 cm×15 cm and the size of each plot was 1.4 m^2. Data was collected on the morphological and yield parameters such as plant height/vine length, number of leaves, number of branches, days to flowering and fruit development, number of fruits, fruit weight, and fruit yield per plant. The study revealed that the performance of Dynasty was best in terms of plant height with an average increase in height of 23.9 cm per week. LHC-1395 was demonstrated to be the variety with the highest increase in leaf number with an average of 2.08 leaves per week. Similarly, the highest number of branches was found to develop in NS-408 (3.2), the highest number of fruits per plant in LHC-1395 (11.36), the highest single fruit weight in LHC-Maria (208.44 grams), and the highest fruit yield per plant in LHC-1395 (2137.9 grams). Thus, the study concluded that LHC-1395 is a high-yielding variety suited for the study area.*

Keywords— ***Cucumber, field experiment, high-yielding variety, Nepal, screen out***

I. INTRODUCTION

Cucumber (*Cucumis sativus* L.) is a fast-growing major vegetable crop grown worldwide (Wehner & Guner, 2004). It is the fourth most important vegetable crop after tomato, cabbage, and onion in Asia (Kalloo & Bergh, 2012); the second most important vegetable crop after tomato in Western Europe (Phu, 1998); and is the fourth most cultivated vegetable in the world after tomatoes, brassicas and onions (Ene et al., 2016). Cucumber is a year-round outdoor vegetable in the tropics and an important greenhouse vegetable, in Northern Europe and North America (Adesina & Benjamin, 2016). In greenhouses, it is cultivated using artificial heating in the winter season (Phu, 1998). At present, cucumber is cultivated as a field crop in most areas of the world under cool climates and as a greenhouse crop (Mallick, 2022). Cucumber can be cultivated when the soil temperature is 60°F or higher, under extremely high temperatures, the fruits may turn green and bitter in many varieties (Brandenberger et al., 2021).

Cucumber belongs to the family Cucurbitaceae (Bist et al., 2020) purposively cultivated for its tender fruits which are eaten raw as salad or cooked as a vegetable. It is reported that the oil extracted from seeds is good for the brain and body. But consuming cucumbers may lead to digestive problems like bloating and flatulence in some people (Garg, 2022). Cucumbers, grown to be eaten fresh (called slices) and those intended for pickling (called picklers) are similar. Cucumbers are mainly eaten in the unripe green

form. The ripened yellow form normally becomes too bitter and sour. Cucumbers usually contain 90% water.

For Nepal, cucumber (*Cucumis sativus* L.) is an important summer vegetable crop commonly grown throughout the country. Cucumber ranks fifth behind cauliflower, tomato, cabbage, and pumpkin in terms of total cultivated area. In the year 2012/13, the total production of cucumber in Nepal was 127,918 tons with a productivity of 14.3 tons/ha (Khanal & Dhakal, 2020) which reached 172,566 Mt. with a productivity of 15.96 Mt./ha in 2018/19 (Bist et al., 2020). During the rainy season, the crop is grown under rain-fed conditions, and during the dry season using irrigation facilities; as a result, the crop can be seen in most vegetable markets in Nepal throughout the year. Though cucumber is one of the most potent commodities from an export point of view, the farmers are not getting reasonable prices due to the failure of the recommended varieties and lack of coordination among the commodity chain actors. Kapilvastu is one of the districts of Nepal lying in Province No. 5, covering an area of 1,738 square km (671 square meters). According to the census 2011, the total population of the area is 571,936. Most of the population of the district is dependent on agriculture. Dharampur, belonging to Buddhabhumi Municipality is one of the major vegetable-growing areas in the district which indicates agriculture, especially vegetable farming being a basis of life for most of the people of the district. Among varieties of crops, cucurbits have been able to establish themselves as the most preferred summer crop by farmers of the district. Farmers in this area import cucumber seeds from the neighboring country like India and follow the local cultivation practices. Thus, this experiment is carried out to identify the most suited varieties of cucumber in the study area by following the package of production that the local farmers have been adopting for many generations.

II. METHOD

2.1 Description of the experimental site

The research was carried out in Dharampur of Buddhabhumi municipality ward no. 10 of Kapilvastu district ranging from an altitude of 93 to 1491 meters above sea level. The geographical coordinates are 27°41' North and 83° 0.02' East (*Buddhabhumi, Kapilvastu, Province #5, 32809, Nepal*, n.d.) and are located in the tropical belt with the summer temperature above 27 °C and winter temperature remains below 15 °C and average rainfall is 1500mm. The physio-chemical condition of the soil of the study site is sandy loam as it is located by the riverside.

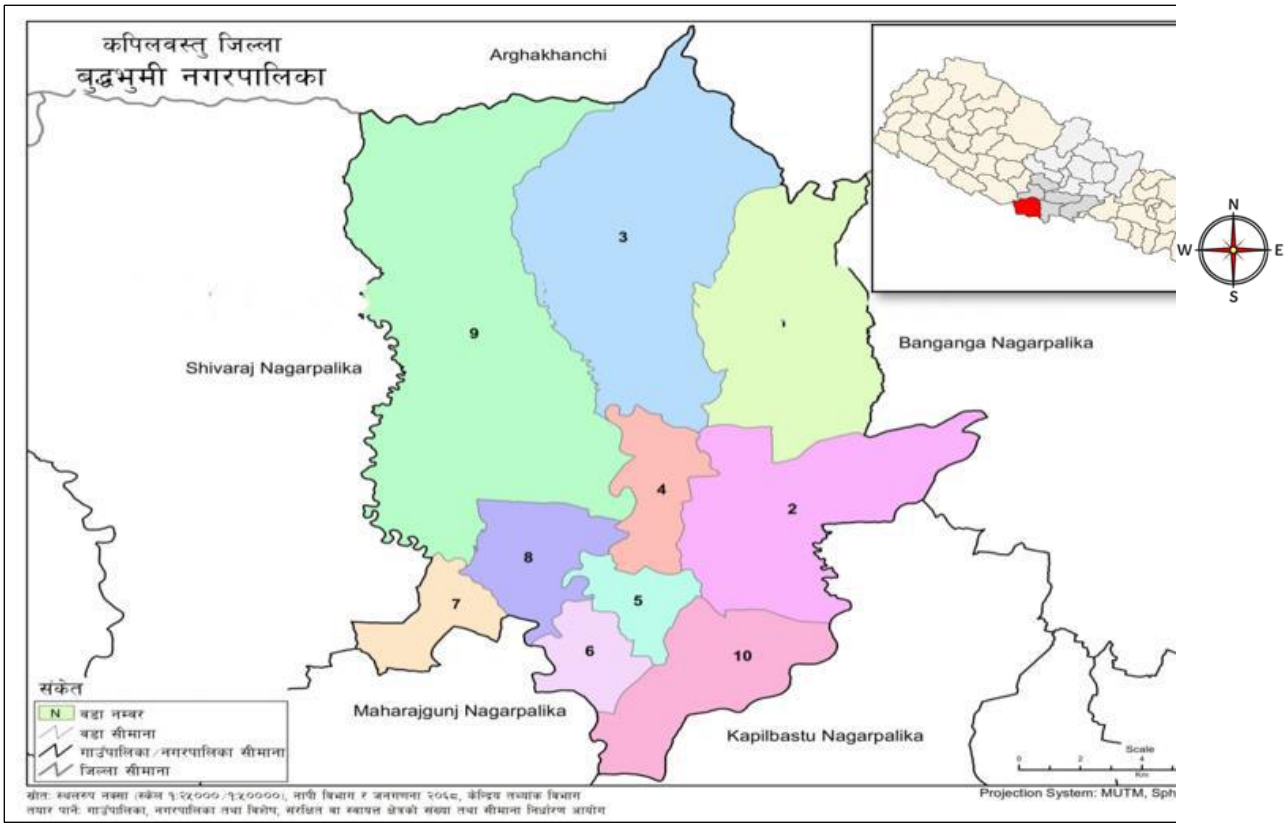

Fig.1. Map of Buddhabhumi Municipality showing wards

2.2 Experimental treatments

The farmers of the study site grow cucumber imported from neighboring countries like India. The varieties studied here are the hybrid varieties of cucumber preferred by the local farmers of the study site.

Table 1 Varieties of cucumber under study in Buddhabhumi Municipality of Kapilvastu district

Notation	Name of Variety	Country of Origin
T1	Rehmat-1080	Thailand
T2	LHC-Maria	India
T3	Dynasty	Korea
T4	Namdhari-NS-408	India
T5	LHC-1395	India

2.3 Design and layout of the experimental plot

The experiment was laid out in an area of 750m^2 with a Randomized Complete Block Design (RCBD) with five replications. The experimental plot was divided into five blocks, each block consisting of five units of plots; thus, composing a total of 25 plots. The individual net plot area was 1.4 m^2 (25*15cm^2) with a net experimental area of 35.16 m^2. Row-to-row spacing was maintained at 25cm and the space between plants was 15 cm thus, comprising 25 plants in each plot. A furrow of 10 cm space was maintained in between the plots for easy intercultural operations. The crop geometry here replicates the ones practiced by the local cucumber growers of the study site.

2.4 Field operations

2.4.1 Land preparation and fertilization

Pre-sowing irrigation and deep plowing followed by 2-3 secondary tillage using harrowing and leveling was carried out 15 days before the planting of cucumber. All the weed and plant residue was removed to make the field clean. Farm Yard Manure (FYM) was well mixed into the soil and the recommended dose of fertilizer in cucumber i.e., NPK@20:40:30 kg/ha was used. Farmyard manure along with the recommended a full dose of P2O5 and K2O, and ½ of the recommended N dose was used as basal dose. The remaining ½ N was used in two split doses of ¼ N just after the first harvest followed by second.

2.4.2 Seed sowing

Seeds were soaked in water for 20 hours and were sown directly in the main field as practiced by farmers on January 15, 2019. Seed sowing followed line sowing with two seeds sown on each hill at a distance of 15 cm from one hill to another. Similarly, the line-to-line distance was maintained at 25 cm. The sowing depth for smaller seeds was 3 cm under moist conditions, and that for larger seeds was 5 cm.

2.4.3 Intercultural operations

2.4.3.1 Weed Management and earthing up

Manual weeding was performed at 10, 20, and 30 days after seed sowing. The earthing up was practiced during the second weeding.

2.4.3.2 Irrigation and Drainage Management

Irrigation was carried out firstly after 2 days of sowing and then, in every 2 day intervals. The irrigation was scheduled according to the critical period of the crop i.e. after sowing, flowering, and fruiting as per requirement. Cucumber being susceptible to water-logging conditions was facilitated by proper drainage systems.

2.4.4 Protection of experimental site and plants

The experimental site was protected with fencing done by iron wire and cemented poles. Similarly, insect pests encountered were controlled by using cattle urine and water solution (1:3-4). Fruit fly was controlled using a pheromone trap and thrips with the yellow sticky trap.

2.4.5 Harvesting

Harvesting time is very crucial for a crop. Earlier harvest as well as delay in harvest may cause yield loss. Thus, harvesting at the physiological maturity stage is very important. Cucumber was harvested multiple times whenever fruits attained a handful size.

2.4.6 Collection of Experimental Data

The morphological and reproductive behaviors of the plants were recorded in every 7 days interval. 5 plants were selected from each plot as sample plants to record for different observations. The height of the main stem (cm), number of primary branches per vine, number of leaves, days to flower initiation, and days to fruit initiation were observed; and the average was calculated. Height was measured by using measuring tape. Yield-related data collection included the number of fruits per plant, average fruit weight per plant, and total yield of fruits.

2.4.7 Statistical analysis

The data was carefully refined and then entered into an MS Excel sheet. The data was analyzed to draw meaningful interferences by using Minitab version 19, and MS Excel 2016 software. Analysis for the variance for all parameters was done by using the Minitab statistical analysis system.

III. RESULTS

3.1 Morphological observations

3.1.1 Germination percentage

Germination percentage was 97% in all five varieties of cucumber. Germination of the plant was recorded by visual analysis.

3.1.2 Plant height/Vine length

The average increase in plant height in a one-week interval of the five varieties demonstrated significant differences ($P \leq 0.05$). The plant vines were found to increase by 18.42 cm on average to 23.9 cm. Among the five varieties, the tallest variety with the highest increase in vine length in 7-day intervals was found to be Dynasty. The average increase in the vine length of this variety was recorded to be 23.9 cm per week. Meanwhile, the shortest variety with the least increase in vine length in one-week intervals was observed to be LHC-Maria. This variety was recorded to grow an average of 18.42cm. The mean increase in plant height of the Dynasty variety was significantly higher than that of varieties NS-408, Rehmat-1080, and LHC-1395 respectively (Figure 2). The result suggests that NS-408 followed the variety Dynasty with an average increase of plant height by 22.76 cm. Similarly, the varieties LHC-1395, LHC-Maria, and Rehmat-1080 were insignificant concerning the increase in plant height with an average increment of 19.17cm, 18.42cm, and 17.82cm respectively.

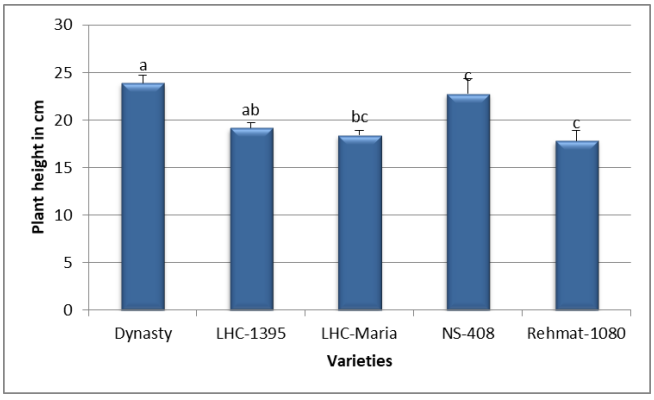

Fig.2 Average increases in plant height per week in different cucumber varieties

3.1.3 Number of leaves

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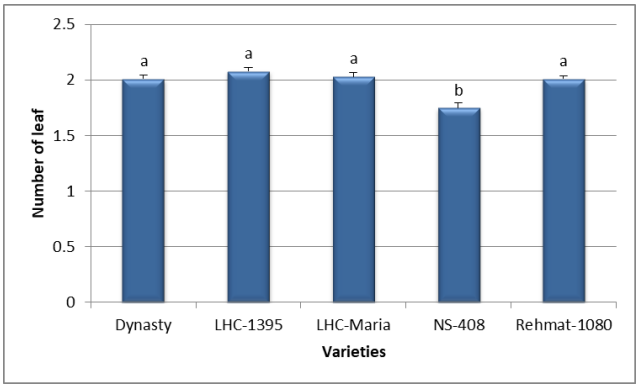

Fig.3 Average increases in leaf number per plant in one-week interval in different cucumber varieties

3.1.4 Number of branches

The increment in branch number of the varieties ranged from 2.72 to 3.2. The statistical analysis revealed that there was no significant difference among the varieties for an increase in the number of branches per plant. All five varieties of cucumber formed almost the same number of branches in the one-week interval. However, the highest number of branches was observed to form in NS-408 i.e., 3.2 whereas the least number of branches was observed in Dynasty and LHC-Maria i.e., 2.72 branches per week (Figure 4). LHC1395 was found to develop 3 branches per week, and Rehmat-1080 developed 2.76 on average. This indicates that NS-408 had vigorous growth in terms of branch number compared to other varieties.

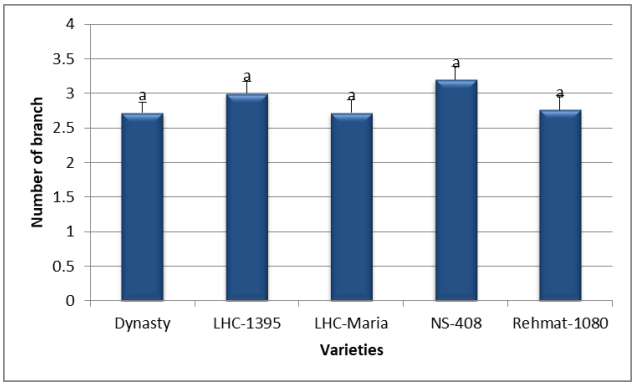

Fig.4 Average increases in branch number per plant in one-week interval in different cucumber varieties

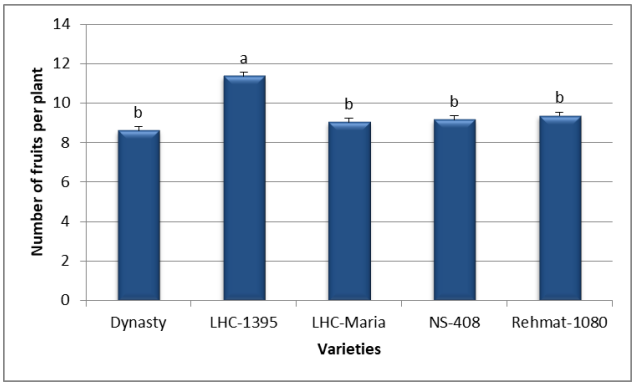

Fig.5 Average numbers of fruits per plant in different cucumber varieties

3.1.5 Days of Flower Initiation

The study showed no significant difference for the days to flower initiation. All five varieties; Dynasty, LHC-1395, LHC-Maria, NS-408, and Rehmat-1080 started flowering at an average of 30 days after planting.

3.1.6 Days of Fruit Development

The five varieties were investigated for the days to fruit development. No significant difference was observed among the varieties LHC-1395, LHC-Maria, Dynasty, NS-408, and Rehmat-1080. All of them were found to start fruit development in an average of 30 days after flower initiation.

3.2 Yield and yield attributes

3.2.1 Number of fruit per plant

The average number of fruits per plant of the varieties ranged from 8.6 to 11.36. Analysis of variance (ANOVA) revealed that there existed significant differences ($P \leq 0.05$) among the varieties for the number of fruits per plant. The highest number of fruits was observed in LHC-1395 with 11.36 per plant. In contrast, the least number of fruits were developed in Dynasty with 8.6 fruits per plant on average. The average number of fruits developed by LHC-1395 is significantly higher than those of LHC-Maria, NS-408, and Rehmat-1080 with fruit yield per plant of 9.04, 9.16, and 9.36 respectively. However, varieties Dynasty, LHC-Maria, NS-408, and Rehmat-1080 did not show much difference among each other. The fruit yield was somewhat equal in them as shown in Figure 5.

3.2.2 Individual fruit weight

The varieties were investigated for individual fruit weight. The Analysis of variance revealed highly significant differences in the individual fruit weight among the five varieties as shown in Figure 6. The highest weight of individual fruit was observed in LHC-Maria with an average fruit weight of 208.44 grams. In contrast, the lowest individual fruit weight was recorded in Rehmat-1080 with an average fruit weight of 133.3 grams. The individual fruit weight of LHC-Maria was significantly higher than that of Rehmat-1080, NS-408, LHC-1395, and Dynasty. The average individual fruit weight of Dynasty was 197.73 grams, LHC-1395 was 190.06 grams, and NS-408 was 174.87 grams. For this trait, the results for LHC-1395 are similar to that of (Choubey et al., 2023). The results indicated that LHC-Maria is a potential variety for higher yield among the five varieties under the study.

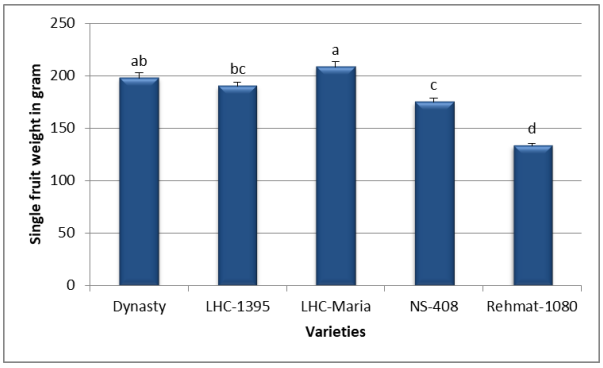

Fig.6 Average individual fruit weight of different cucumber varieties

3.2.3 Total fruit yield per plant

The average fruit yield in the five varieties ranged from 1239.7 grams to 2137.9 grams. The statistical analysis revealed that there was a significant difference among the varieties for the total fruit yield per plant. Among the five

varieties, the highest yield was recorded in LHC-1395 with 2137.9 grams per plant whereas, the least yield was observed in Rehmat-1080 with 1239.7 grams per plant. The LHC-1395 yielded significantly higher in comparison to other varieties as shown in Figure 7. The yield of the LHC-1395 was followed by LHC-Maria with an average total yield of 1859.8 grams. This yield is more than that of Dynasty which yielded 1674.5 grams, and NS-408 which yielded 1580.9 grams. The yield for Rehmat-1080 is unsatisfactory as compared to the 2-3 kg average fruit weight per plant mentioned by (*Rehmat 1080*, n.d.). The results suggested that LHC-1395 is a high-yielding variety of cucumber with the highest total fruit yield per plant among the five varieties under the study. (Choubey et al., 2023) also mentioned LHC-1395 as a high-yielding hybrid variety of cucumber in their study.

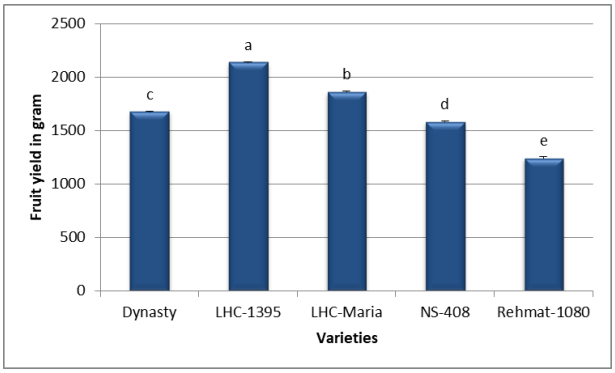

Fig.7 Yield per plant of different cucumber varieties

IV. CONCLUSION

Varietal screening is a foremost step during the cultivation of crops in a specific area as it directly affects the yield. The fact cannot be ignored that the farmers favor the cultural practices that they have been practicing for many generations. Thus, this study has been focused on selecting the best exotic variety for the study site using the same package of production that the local farmers have been using. During the study, among the five varieties selected, none were seen as equal in results in the context of the yield. The variety LHC-1395 yielded highest, followed by LHC-Maria, Dynasty, NS-408, and Rehmat-1080 respectively, and thus, LHC1395 is the best-suited variety for the area, followed by LHC-Maria. The overall performance of LHC-1395 is good compared to other varieties in terms of both vegetative and reproductive attributes. This variety is found to be competitive with other varieties in terms of the number of leaf and branch development per week. Moreover, it exhibits a good capacity for fruiting as the number of fruits per plant was found highest; also, the individual fruit weight was higher in comparison to other varieties i.e., NS-408, and Rehmat-1080. Thus, it can be concluded from the investigation that LHC-1395 is a superior variety for the study area under the local cultivation practices.

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Appendix 1: Change in different morphological and yield attributes

Varieties	Average plant height (cm)	Number of leaves	Number of branches	Number of fruit	Average fruit weight (kg)	Total yield (kg)
Dynasty	23.900±0.823a	2.0100±0.0306a	2.720± 0.147a	8.600± 0.208b	197.73 ±5.28ab	1674.5 ±5.72c
LHC-1395	19.165±0.576ab	2.0800±0.0345a	3.000± 0.173a	11.360 ±0.230a	190.06 ±3.88bc	2137.9 ±6.10a
LHC-Maria	18.420±0.479bc	2.0300±0.0363a	2.720± 0.187a	9.040 ±0.212b	208.44 ±5.09a	1859.8 ±10.5b
NS-408	22.76±1.58c	1.7500 ±0.0408b	3.200±0.191a	9.160 ±0.221b	174.87 ±4.03c	1580.9± 8.07d
Rehmat-1080	17.82±1.09c	2.0100±0.0227a	2.760 ±0.202a	9.360 ±0.181b	133.30 ±2.26d	1239.7 ±13.8e