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# Standardization of production technology for cucumber (*Cucumis sativus* L.) under protected environment

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**Abstract**

An experiment was conducted to standardize the production technology for cucumber (*Cucumis sativus* L.) under protected cultivation at Central Institute of Arid Horticulture, Bikaner during the year 2010-11. The experiment was laid out in Randomized Block Design with factorial concept comprised of three environments namely, glasshouse, polyhouse and net house and five varieties (Isatish, Hilton, Alamgir-CT-180, Poona Khira, Himangi) of cucumber. The results indicated a significant difference in all the vegetative growth parameters studied. The maximum vine length (3.01m), number of leaves (24.53), number of branches (1.75) and leaf area (448.37 $cm^2$), respectively were found in glasshouse. Among different varieties of cucumber maximum vine length (3.26 m), number of leaves (29.96), number of branches (1.73) and leaf area (449.71 $cm^2$) were recorded in variety Isatish. As far as effect of protected structure have a significant influence on photosynthetic rate (µm $CO_2/m^2/s$), transpiration rate (µm $H_2O/m^2/s$) and chlorophyll content (mg/g of fresh weight). The maximum photosynthetic rate (12.83 µm $CO_2/m^2/s$) and chlorophyll content (1.30 mg/g) were found in glasshouse. Maximum yield per hectare (84.06) recorded in cucumber crop raised under glasshouse condition. Among the varieties, maximum yield per hectare (86.78 t/ha) were recorded in variety Isatish, whereas, the minimum yield per hectare (59.01) was recorded in variety Himangi.

**Key words:** Cucumber, Zero energy polyhouse, Net house, Glasshouse, Cultivars, Parthenocarpic.

## Introduction

Cucumber *(Cucumis sativus* L.) which belongs to family cucurbitaceaes is one of the important vegetable crops from nutritional as well as economic point of view. It is a warm season vegetable grown throughout the country under tropical and sub-tropical conditions. It is said to be the native of Northern India *(*Pursglove*,* 1969). The fruit of cucumber is said to have cooling effect, prevent constipation, checks jaundice and indigestion *(*Nandkarni*,* 1927*).* Polyhouse cultivation is an emerging trend for growing vegetables in India. Production of cucumber in India is mainly restricted to its open field cultivation. It is mainly grown in summer and rainy season in Northern plains of India. Nevertheless, biotic and abiotic stresses are the main factors responsible for low yield and poor quality under open field cultivation. Summer season crop is mostly successful due to less incidence of diseases and pests, but rainy season crop is always affected by diseases and pests, resulting into low productivity and poor quality of fruits. Singh *et al*., (2005) suggested that Hasan and Sarig cultivars of cucumber are ideal for greenhouse cultivation during summer and rainy season, while Muhasun, Isatis, Dinar, Nun 9729, Nun 3019 and Kian can be grown successfully in winter season.

India, bestowed with a diverse and extreme ago-climatic conditions, has enormous potential for the protected vegetable cultivation technology, which can be utilized for the year round production of high value quality vegetable crops combined with high yield. Protected cultivation actually achieves higher water and nutrient use efficiencies. Increasing photosynthetic efficiency and reduction in transpiratory losses are added advantages of protected cultivation (Singh *et al,*. 2005). Both of these factors are of vital importance for healthy and luxuriant growth of crop plants. This technology is highly suitable for farmers in peri-urban areas of the country, especially in Northern plains of India. But protected cultivation requires careful planning and attention including selection of

varieties, suitable production technology like spacing, time of sowing and planting, water and nutrient management and plant protection to produce achieve yield of good quality. In view of importance of cucumber crop, the study was initiated to find out suitable the cultivar and suitable structures for cucumber cultivar under different type of green house structures.

**Material and methods**

The experiment was conducted at ICAR-Central Institute of Arid Horticulture, Bikaner, during the *kharif,* 2010. Bikaner is situated at $28.01^0$N latitude and $73.22^0$E longitude at an altitude of 234.70 meters above mean sea level. According to "Agro-ecological region map" brought out by the National Bureau of Soil Survey and Land Use Planning (NBSS&LUP) it falls under Agro-ecological region No. 2 (MgE1) under Arid ecosystem (Hot Arid Eco-region with desert and Saline soil). The fertigation method was used to apply nitrogen, phosphorus and potassium in liquid form along with irrigation water as NPK was used 22 kg as per recommendation of the crop. For green house cultivation of cucumber, the seedlings were raised on soil-less media in plastic protrays having cells of 1.5" in size. The seedlings were ready for transplanting within 15-18 days. Three weeks old seedlings at 2-3 true leaf stage were transplanted at 60 cm× 60 cm according to the different treatment combinations.

The experiment was laid out in Randomized Block Design with factorial concept comprised of three environments namely, glasshouse, poly house and net house and five varieties (Isatish, Hilton, Alamgir-CT-180, Poona Khira, Himangi) of cucumber.

All the cultural practices including irrigation and hoeing were carried out, following the standard commercial procedures. Spraying for protection from pests and diseases were done whenever it appeared necessary throughout the growing season. Vines were vertically trained and maintained as single stems by the continuous pruning of all laterals.

The growth and physiological parameter were recorded from randomly selected five tagged plants of each treatment and further analyzed. All data were subjected to analysis of variance to determine main treatment effect and interactions.

**Results and discussion**

**Vegetative growth characters**

It is evident from the data (Table 1) that various types of structures and cultivars had significant effect on vegetative growth parameters of cucumber like, number of branches, average length of vine (m), average number of leaves and leaf area ($cm^2$). As far as winter season was concerned various structures had significant influence on number of branches, average length of vine, average number of leaves and area of leaves. The maximum number of branches per vine (1.75), average length of vine (3.01 m), and leaf area (448.37 $cm^2$) were measured in glasshouse followed by polyhouse. Among the various vegetative growth parameter leaf area is an important variable for most of the physiological processes involving light interception for photosynthesis and potential evapotranspiration. Moreover, the rate of photosynthesis increased with the increase in carbon dioxide supply up to a certain extent. It is ubiquitous that vegetative growth is directly influenced by the photosynthetic activity (Pandey and Sinha, 2007). Light is also responsible for effecting the rate of photosynthesis in various ways. Few of ultraviolet light having shorter wave length apparently increased the photosynthetic rate (Pandey and Sinha, 2007). Temperature has little effect on the rate of the photosynthesis. However, very high and low temperature range affects the photosynthesis rate adversely. As the light intensity, carbon dioxide concentration and temperature inside the glasshouse was optimum for the growth and development of cucumber. Whereas, in case of polyhouse short wave radiation transmitted inside and long radiation transferred out. Thereby increased the inside temperature and resulted in lesser growth and yield as compared to glasshouse (Dwivedi and Dwivedi, 2005).

Similarly, Kwon and Chang (1996) reported that the length of the main stem before branching divergence was longest in chilli grown in glasshouse because of better environmental conditions. The glasshouse was the most favourable environment, as a result of a high transmittance of solar radiation, suitable temperatures for plant assimilation, and other environmental factors. However, appropriate cultivation techniques are also needed for the high yield to minimize the adverse effects of climate and soil.

Further, Table-1 showed that the maximu number of leaves (29.96), number of branches (1.75) and length of vine (3.26 cm) were recorded with variety Isatish however, leaf area (449.04 $cm^2$) was observed with variety Hilton than the other variety. The significant difference in vegetative growth parameters, such as number of leaves, number of branches, leaf area ($cm^2$) between cultivars may be due to varietal characteristic. Significant difference was observed among the cultivars for the vegetative growth characters by Al-Harbi *et al.* (1996) and Ramirez *et al.* (1988) in cucumber.

**Flowering characters**

Data clearly showed that the cultivars and different type of structures along with their interaction effects had significantly influenced the flowering characteristics as days to first flowering. Among the various protected structures, the least number of days to first flowering was recorded in glasshouse (37.60) followed by polyhouse (38.68). Favourable environmental conditions resulted in better vegetative growth and optimum photosynthesis. The

glasshouse resulted in more assimilation of photosynthates and accelerated the flower initiation. Further, in cucumber the flowers appear on every node of the vine; therefore, increased vine length resulted in more flowering and ultimately more fruit set. The similar results have also been reported by Kwon and Chang (1996).

Among the various cultivars, least number of days required for first flower initiation was recorded in cultivar Isatish (36.80) followed by Hilton (37.42). It has been reported that auxin can induce pistillate flower formation through its stimulation of ethylene production. An Auxin/IAA transcription factor was found to have higher expression in hermaphroditic flowers (Guo *et al,* 2010). The findings of the present investigation are in close conformity with the findings of Gulam ud din *et al.* (2006) Guo *et al.* (2010) in cucumber and Kwon and Chang (1996) in chillies.

**Physiological parameters**

It is evident from the data presented in Table-1, the effect of structure have a significant influence on photosynthetic rate (µm $CO_2/m^2/s$), transpiration rate (µm $H_2O/m^2/s$) and chlorophyll content (mg/g of fresh weight). The maximum photosynthetic rate (12.83 µm $CO_2/m^2/s$) and chlorophyll content (1.30 mg/g) was found in glasshouse. Whereas, minimum transpiration rate (1.02 µm $H_2O/m^2/s$) was found in glasshouse. The photosynthetic rate, transpiration rate and chlorophyll content are dependent on different factors such as $CO_2$ concentration, temperature, light intensity, humidity, air temperature etc. Carbon makes up about 40 per cent of the dry matter, weight of higher plant, therefore, $CO_2$ concentration enrichment increased photosynthesis and plant productivity significantly. Increased $CO_2$ concentration in glasshouse (300-1000ppm) has been reported to increase photosynthesis and decreased stomatal conductance in most of the crop plant resulting in reduced transpiration rate per unit area of leaf and overall increase in water use efficiency (Dwivedi and Dwivedi, 2005). Reduced transpiration will alter the microclimate particularly, the selective humidity in immediate environment of plant which will have implication for other living organism sharing the same ecosystem with the plant.

**Yield and yield attributing characters**

Among the various yield attributing characters number of pickings (3.93), fruit length (13.52 cm), average fruit girth (3.50 cm), number of fruits per vine (20.37), weight of fruits per vine (3.52 kg), Average fruit weight (155.22 gm), yield/$m^2$ (8.41 kg/ $m^2$) and fruit yield/ha (84.06 t/ha) were recorded maximum in glasshouse (Table-2). As higher chlorophyll content and maximum leaf area under glasshouse resulted in better vegetative growth, which ultimately envisaged the plants to enter into the reproductive phase. The length of vine was maximum under glasshouse, which resulted in flower bud formation on each node, better fruit set, fruit development and fruit weight. In addition, microclimatic conditions in glasshouse was also favourable for plant growth characteristic as well as for yield parameters. Similar effects were observed by Sezen *et al.* (2010) and Champugain *et al*. (2004) in tomatoes.

Similarly, the early and total yield enhanced in pepper grown under glasshouse (Dasgum and Abak, 2003). It is a well known fact that the yield of vegetables under greenhouse condition depends on various factors such as variety, temperature, humidity, $CO_2$ concentration etc. Gucan *et al*. (2006) stated that the cucumber yield in unheated greenhouse was 8-10kg/$m^2$ and 11-12 kg/$m^2$ in autumn and spring production period, respectively. The significant fruit length and fruit width in *Capsicum* was also reported in glasshouse ( Pandey *et al*., 2005). However, as the full season progressed, the average temperature was getting cooler and day length shorten which caused the fruit to take more days to attain a proper length (Kwon and Chan, 1996).

Among different cultivars the maximum number of pickings (5.13), average fruit length (14.57), fruit girth (4.17), number of fruits per vine (21.44), weight of fruits per vine (3.67 kg) and highest fruit weight (152.98 g) was obtained in cultivar Isatish. The significantly higher yield was recorded in cultivar Isatish (8.68 kg/$m^2$) followed by Hilton (7.78 kg /$m^2$). In gynoecious varieties of cucumber under glasshouse condition resulted in higher level of auxin and lower level of ABA which ultimately favoured more fruit set and better development of fruit parthenocarpically. It has been reported that auxin can induce pistillate flower formation through its stimulation of ethylene production. (Guo *et al.,* 2010). The more fruit set per vine under glasshouse condition with more accumulation of food material in leaves and its transfer to developing fruits, which affected the fruit length and width and ultimately significant increase in fruit yield per plant and yield per square meter was observed as evident from the data (Chapagain *et al.,* 2004).

**Fruit quality characters**

The data presented in Table-3 revealed that the various cultivars had resulted in significant increase in vitamin C content (mg/100g), fiber content (%), calcium content (mg/100g), phosphorus content (mg/100g), iron content (mg/100g). Among different cultivars, the maximum vitamin C (6.37 mg/100g), phosphorus content (21.22 mg/100g), iron content (1.89 mg/100g) and the minimum fiber content (0.78 %) were found in cultivar isatish. However, calcium (15.00 mg/100g) was observed with variety Hilton than the other varieties. This might be due to genetic expression in the cucumber cultivars. The cucurbitacaeous crop is known to be controlled by different genetic environment and hormonal factors. Fruit quality is also determined by the gene expression of a particular

variety under favourable climatic condition in greenhouse (Manzano *et al.,* 2008). Auxin induced pistillate flower formation through its stimulation of ethylene production; therefore, number of female flower were measured and it has been reported that the ethylene has higher genetic expression in case of gynoecious line which could be a reabon for improved performance of Isatish and Hilton variety under glasshouse. (Guo *et al.,* 2010).

**Economics**

The findings of the present studies reflected that the net returns were significantly affected by different types of structures. It is clear from the data that maximum net returns and B:C ratio can be obtained by the poly house structure with Rs. 35821/- per 500 $m^2$ and 2.18, respectively. Whereas in case of cultivar, the maximum net return and B:C ratio was found with Isatish (Rs. 41049/- per 500 $m^2$ and 2.20, respectively). Similar economic results have been reported by Cantliff *et al.* (2008). Protected cultivation of vegetable offer distinct advances of quality, productivity and favorable market price to growers in adverse climatic conditions. Vegetable growers can substantially increase their income by protected cultivation of vegetables in off season production (Singh *et al.,* 2006).

The construction cost of glasshouse was high and there was no subsidy. Whereas, in case of poly house and net house there was subsidy of 70 per cent and initial investment was less compared to glasshouse. Therefore, the net returns under the glasshouse was on negative side.

Table 1. Effect of environments and varieties on yield and yield attributes

| Environments | No. of leaves/ vine | No. of branches /vine | length of vine (cm) | Leaf area | Photosynthesis rate (µm $CO_2/m^2/S$) | Transpiration rate (µm $H_2O/m^2/S$) | Chlorophyll content (mg/g fresh weight) |
|---|---|---|---|---|---|---|---|
| Environments | | | | | | | |
| Poly house (P) | 24.17 | 1.60 | 2.84 | 426.41 | 10.39 | 1.46 | 1.21 |
| Net house (N) | 23.04 | 1.32 | 2.71 | 404.15 | 8.58 | 1.57 | 1.11 |
| Glass house (G) | 24.53 | 1.75 | 3.01 | 448.37 | 12.83 | 1.02 | 1.30 |
| C.D. (5%) | NS | 0.09 | 2.84 | 27.31 | 2.37 | 0.21 | 0.09 |
| Varieties | | | | | | | |
| Isatish ($V_1$) | 29.96 | 1.73 | 3.26 | 445.47 | 11.03 | 1.40 | 1.25 |
| Hilton ($V_2$) | 25.40 | 1.60 | 3.13 | 449.04 | 11.04 | 1.38 | 1.26 |
| Alamgir-ct-180 ($V_3$) | 22.02 | 1.47 | 2.80 | 414.67 | 10.34 | 1.33 | 1.18 |
| Poona Khira ($V_4$) | 21.80 | 1.53 | 2.65 | 416.29 | 10.38 | 1.35 | 1.20 |
| Himangi ($V_5$) | 20.40 | 1.44 | 2.43 | 405.76 | 10.21 | 1.31 | 1.15 |
| C.D. (5%) | 2.17 | 0.11 | 0.20 | 27.31 | NS | NS | NS |
| Interaction | | | | | | | |
| $PV_1$ | 31.13 | 1.80 | 3.26 | 443.20 | 9.91 | 1.40 | 1.26 |
| $PV_2$ | 25.33 | 1.73 | 3.12 | 449.53 | 10.92 | 1.80 | 1.27 |
| $PV_3$ | 21.27 | 1.47 | 2.68 | 415.60 | 10.10 | 1.38 | 1.19 |
| $PV_4$ | 22.00 | 1.60 | 2.63 | 416.60 | 7.92 | 1054 | 1.21 |
| $PV_5$ | 21.13 | 1.40 | 2.51 | 407.13 | 13.08 | 1.20 | 1.15 |
| $NV_1$ | 26.07 | 1.40 | 3.07 | 420.53 | 9.04 | 1.59 | 1.15 |
| $NV_2$ | 23.60 | 1.33 | 3.00 | 427.27 | 6.05 | 1.44 | 1.17 |
| $NV_3$ | 22.07 | 1.27 | 2.48 | 397.60 | 9.90 | 1.82 | 1.09 |
| $NV_4$ | 22.87 | 1.27 | 2.54 | 393.60 | 12.05 | 1.48 | 1.10 |
| $NV_5$ | 20.60 | 1.33 | 2.49 | 381.73 | 5.88 | 1.54 | 1.06 |
| $GV_1$ | 32.67 | 2.00 | 3.44 | 471.67 | 14.15 | 1.20 | 1.34 |
| $GV_2$ | 27.27 | 1.73 | 3.26 | 472.33 | 16.16 | 0.90 | 1.35 |
| $GV_3$ | 22.73 | 1.67 | 3.25 | 430.80 | 11.01 | 0.78 | 1.26 |
| $GV_4$ | 20.52 | 1.73 | 2.80 | .438.67 | 11.16 | 1.04 | 1.29 |
| $GV_5$ | 19.47 | 1.60 | 2.29 | 428.40 | 11.66 | 1.20 | 1.26 |
| C.D. (5%) | NS | NS | 0.34 | NS | NS | NS | NS |

Table 2. Effect of environments and varieties Vegetative and Physiological parameter

| Treatments | Days to first flowering | No. of pickings | Average fruit length (cm) | Average fruit girth (cm) | Number of fruits/ vine | Weight of fruits / vine (kg) | Average fruit weight (gm) | Yield/$m^2$ (gm) | Fruit yield (t/ha) | B:C ratio |
|---|---|---|---|---|---|---|---|---|---|---|
| Environments | | | | | | | | | | |
| Poly house (P) | 38.68 | 3.57 | 12.47 | 3.38 | 19.25 | 3.19 | 144.41 | 7.56 | 75.59 | 2.18 |
| Net house (N) | 39.83 | 3.31 | 11.89 | 3.22 | 17.32 | 2.49 | 121.32 | 5.67 | 56.72 | 2.01 |
| Glass house (G) | 37.60 | 3.93 | 13.52 | 3.50 | 20.37 | 3.52 | 155.22 | 8.41 | 84.06 | 0.95 |
| C.D. (5%) | 1.61 | 0.48 | 0.80 | 0.20 | 0.62 | 0.17 | 10.70 | 0.33 | 3.28 | 0.10 |
| Varieties | | | | | | | | | | |
| Isatish ($V_1$) | 36.80 | 5.13 | 14.57 | 4.17 | 21.44 | 3.67 | 152.98 | 8.68 | 86.78 | 2.20 |
| Hilton ($V_2$) | 37.42 | 4.80 | 13.89 | 4.05 | 19.40 | 3.33 | 150.56 | 7.78 | 77.82 | 1.98 |
| Alamgir-ct-180 ($V_3$) | 40.62 | 2.96 | 11.98 | 3.02 | 17.96 | 2.87 | 135.22 | 6.62 | 66.20 | 1.43 |
| Poona Khira ($V_4$) | 38.64 | 2.69 | 12.10 | 3.06 | 18.96 | 3.05 | 138.29 | 7.08 | 70.81 | 1.57 |
| Himangi ($V_5$) | 40.02 | 2.44 | 10.60 | 2.53 | 17.16 | 2.42 | 124.54 | 5.90 | 59.01 | 1.40 |
| C.D. (5%) | 2.08 | 0.62 | 1.03 | 0.26 | 0.82 | 0.22 | 13.81 | 0.42 | 4.24 | 0.13 |
| Interaction | | | | | | | | | | |
| $PV_1$ | 110.80 | 5.20 | 14.69 | 4.18 | 21.40 | 3.57 | 155.27 | 8.90 | 88.97 | 2.78 |
| $PV_2$ | 111.60 | 4.87 | 13.59 | 4.05 | 18.60 | 3.39 | 166.47 | 8.33 | 83.27 | 2.60 |
| $PV_3$ | 121.20 | 2.93 | 12.01 | 3.03 | 18.20 | 2.87 | 139.55 | 7.06 | 70.60 | 1.88 |
| $PV_4$ | 115.80 | 2.53 | 11.89 | 3.04 | 19.27 | 3.55 | 137.93 | 7.36 | 73.63 | 1.95 |
| $PV_5$ | 120.80 | 2.33 | 10.24 | 2.58 | 18.80 | 2.59 | 122.83 | 6.15 | 61.47 | 1.72 |
| $NV_1$ | 115.20 | 4.20 | 13.47 | 4.05 | 19.27 | 2.66 | 128.53 | 6.51 | 65.13 | 2.46 |
| $NV_2$ | 116.60 | 3.93 | 13.23 | 3.89 | 18.33 | 2.33 | 116.40 | 5.68 | 56.83 | 2.15 |
| $NV_3$ | 125.80 | 2.80 | 11.34 | 2.81 | 16.47 | 1.98 | 109.29 | 4.93 | 49.27 | 1.63 |
| $NV_4$ | 120.20 | 2.87 | 11.35 | 3.01 | 17.47 | 2.98 | 129.87 | 6.00 | 60.03 | 1.98 |
| $NV_5$ | 119.60 | 2.77 | 10.07 | 2.33 | 15.07 | 2.51 | 122.50 | 5.23 | 52.33 | 1.84 |
| $GV_1$ | 105.20 | 6.00 | 15.55 | 4.29 | 23.67 | 4.77 | 175.13 | 10.62 | 106.23 | 1.35 |
| $GV_2$ | 108.60 | 5.60 | 14.83 | 4.20 | 21.27 | 4.28 | 168.80 | 9.34 | 93.37 | 1.19 |
| $GV_3$ | 118.60 | 3.13 | 12.60 | 3.23 | 19.20 | 3.76 | 156.82 | 7.87 | 78.73 | 0.79 |
| $GV_4$ | 111.80 | 2.67 | 13.12 | 3.13 | 20.13 | 2.62 | 147.07 | 7.88 | 78.75 | 0.78 |
| $GV_5$ | 119.80 | 2.27 | 11.48 | 3.67 | 17.60 | 2.17 | 128.30 | 6.32 | 63.22 | 0.64 |
| C.D. (5%) | NS | NS | NS | NS | 1.42 | 0.38 | NS | 0.73 | 7.34 | 0.22 |

Table 3. Effect of environments and varieties on quality parameter

| Treatments | Ascorbic acid (mg/100g) | Fiber content (%) | Calcium (mg/100g) | Phosphorus (mg/100g) | Iron (mg/100g) |
|---|---|---|---|---|---|
| Environments | | | | | |
| Poly house | 5.76 | 0.98 | 13.68 | 19.64 | 1.64 |
| Net house | 5.50 | 0.97 | 13.48 | 19.24 | 1.62 |
| Glass house | 5.78 | 1.01 | 13.88 | 19.91 | 1.70 |
| C.D. (5%) | NS | NS | NS | NS | NS |
| Varieties | | | | | |
| ISATISH | 6.37 | 0.78 | 14.67 | 21.22 | 1.89 |
| HILTON | 6.10 | 0.91 | 15.00 | 21.11 | 1.86 |
| ALAMGIR-CT-180 | 5.47 | 1.24 | 12.09 | 18.13 | 1.41 |
| POONA KHIRA | 5.57 | 0.95 | 13.97 | 19.60 | 1.70 |
| HIMANGI | 4.90 | 1.04 | 12.67 | 17.91 | 1.42 |
| C.D. (5%) | 0.36 | 0.11 | 1.36 | 1.54 | 0.18 |

| Interaction | | | | | |
|---|---|---|---|---|---|
| $PV_1$ | 6.70 | 0.77 | 15.00 | 20.67 | 1.73 |
| $PV_2$ | 6.30 | 0.85 | 16.00 | 21.33 | 2.01 |
| $PV_3$ | 5.20 | 1.20 | 11.09 | 18.13 | 1.32 |
| $PV_4$ | 5.80 | 0.97 | 14.30 | 20.93 | 1.72 |
| $PV_5$ | 4.80 | 1.10 | 12.00 | 17.13 | 1.43 |
| $NV_1$ | 6.10 | 0.73 | 15.00 | 21.67 | 1.83 |
| $NV_2$ | 5.90 | 0.90 | 14.00 | 19.33 | 1.77 |
| $NV_3$ | 5.10 | 1.40 | 13.09 | 17.13 | 1.42 |
| $NV_4$ | 5.30 | 0.90 | 12.30 | 19.93 | 1.54 |
| $NV_5$ | 5.10 | 0.90 | 13.00 | 18.13 | 1.57 |
| $GV_1$ | 6.31 | 0.83 | 14.00 | 21.33 | 2.11 |
| $GV_2$ | 6.10 | 0.97 | 15.00 | 22.67 | 1.81 |
| $GV_3$ | 6.10 | 1.13 | 12.09 | 19.13 | 1.49 |
| $GV_4$ | 5.60 | 0.98 | 15.30 | 17.93 | 1.84 |
| $GV_5$ | 4.80 | 1.13 | 13.00 | 18.47 | 1.26 |
| C.D. (5%) | NS | NS | NS | NS | NS |

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