Original Research Article

Effect of different irrigation levels and potato hybrids on yield and nutrient uptake of the crop under water stress conditions

Abstract

As the scarcity of water increases, India will face the problem of decreasing annual freshwater use per capita. Healthy and sufficient crop and food production are very much essential for everyone due to the population increasing globally. Drought can result in severe productivity losses, especially for crops like the potato (*Solanum tuberosum*) that have shallow roots. In agriculture, it's critical to keep an eye on the soil, the climate, and the water supply for a crop. An experiment was carried out to measure the effects of different levels of irrigation on yield parameters of different potato hybrids under water stress conditions during the winter season 2018-19 at the field of department of vegetable science in CCS Haryana Agricultural University, Hisar. The experiment included four irrigation levels I_1 (irrigation at 20mm Cummulative Pan Evaporimeter (CPE)), I_2 (irigation at 25mm CPE), I_3 (irrigation at 30mm CPE) and I_4 (irrigation at 30mm CPE + 5 t/ha grass mulch) and five potato hybrids V_1 (P-21), V_2 (P-32), V_3 (P-37), V_4 (P-38), V_5 (Kufri Bahar) under two different crops at 60 and 75 days. The results revealed that parameters i.e., number of leaves, total tuber yield and nitrogen uptake by crop were higher in both 60 and 75 days of crops under irrigation level 20 mm CPE (I_1) and hybrid P-38 but in water stress condition I_3 gives better yield than other irrigation levels with hybrid -38.

Keywords: Water stress, Potato hybrids, Nutrient uptake, Specific gravity, CPE

Introduction

Major obstacles to crop productivity may result from abiotic stressors. Due to their ability to reduce the average yield of most crops by 50–70%, abiotic stressors like heat, salinity, and water shortage are the primary causes of crop loss Chai *et. al.*, 2014. Drought is one of the most influential abiotic stresses Seleiman *et. al.,* 2021.

Water scarcity is increasing as the population grows, which means that the need for freshwater is increasing as well. As a result of excessive water use and pollution over the last two decades. The annual freshwater supply per capita has decreased by more than 20%, around 1.2 billion people around the world are facing water scarcity due to their habitation in agricultural areas Akash *et. al.,* 2023. In the world, 92% of all freshwater is used for agricultural purposes, whether it's in the form of rivers, lakes, or underground aquifers Zhai *et. al.,* 2019. India will face a challenge in the coming decades to increase food production to feed a growing population while concurrently reducing annual freshwater consumption per capita. In many parts of the world, a lack of water is the main barrier to the production of potatoes. Both agronomists and potato grower farmers have high expectations for increased tuber yields per unit of water Anonymous, 2001.

Potato (*Solanum tuberosum* L.) is a major crop grown in almost 150 countries globally. It is the world's fourth most cultivated crop, after wheat, rice, and maize. Potato is a member of the Solanaceae family and is one of the most important tuberous crops grown in India. It is native to South and Central America Saenkaew, 2008. This crop generates more edible energy and protein per unit area and time than many other crops and has an extraordinarily high yield (up to 25-30 t/ha). It contains a lot of carbohydrates, protein, and vitamin C. On the global stage, the production of potatoes is 370 metric tonnes and 17.3 million cultivated hectares Anonymous, 2021. India is the world's second largest potato producer after China, with an average output of 24.4 t/ha. In 2021–22, the area and production of potatoes in India were 22.02 lakh hectares, yielding 533.87 lakh metric tons. In 2021-22, the area and production and productivity of potatoes in Haryana were 29.54 thousand hectares, 7.82 lakh metric tonnes, and 26.49 mt/ha, respectively, Anonymous, 2021.

Potato is considered a drought-sensitive crop and are subjected to yield loss due to drought stress. Also as climate change, the severity, frequency, and extent of droughts have been increasing worldwide. Potato's susceptibility to dryness has mostly been attributed to their weak roots. In the last few decades, several studies reported that the susceptibility of potatoes to drought depends on their genotype, stage of development, shape, and the length and severity of the drought stress. On the other hand, some researcher thought that the depth of the roots is the only main reason why potatoes are sensitive to dryness Nasir and Toth, 2022. The biggest difficulty in restricting good potato yield to meet global demand is irrigation scheduling, which can be mitigated by effective water management and agronomic measures such as mulching.

Nitrogen is a key element for improving crop growth, development and quality of crop plants. It influences the yield mainly through leaf area expansion, crop development, crop quality and susceptibility to lodging and can also affect the behavior of other elements Devi *et. al.*, 2023. Excessive or insufficient water availability have an impact on potato development and production Fleisher *et. al.*, 2008. Mulching applications efficiently affect the plant's hydrothermal microenvironment; although, the effects of mulching on potato yield vary with field management and climate. Straw and plastic mulching boosted potato output by 24.3% and 16.0%, respectively, while increasing water use efficiency (WUE) by 5.6% and 28.7%.

There is still a large effect of mean growing season air temperature, water input, soil basic fertility and fertilizer treatments on potato output.

Potato acts as indicator crop for potassium deficiency symptoms due to its higher potassium requirement. Potassium plays an important role in photosynthesis through enzyme activation, carbohydrate metabolism, water regulation, translocation of assimilates and nitrogen uptake. Also, it has a role in physiological processes in plant respiration, transpiration, translocation of sugars and carbohydrates and enzyme transformation. It enables the plant to synthesize the organic compounds linked with the absorption of nitrogen and its efficient utilization Devi *et. al.,* 2023.

The result of this study would be worthwhile to find out the effect of different irrigation levels and potato hybrids on yield and nutrient uptake of the crop under water stress conditions.

2. MATERIAL METHOD

2.1 Experimental Design

The proposed study was carried out in an open field at research farm of the Department of Vegetable Science, Chaudhary Charan Singh Haryana Agricultural University, Hisar during rabi season, 2018-19. Hisar is situated at latitude of 29^o 10’ N, longitude of 75^o 46’ E and at the height of 215.2 meters above mean sea level and falls in semi-arid and sub-tropical region with hot and dry summer and severe cold in winter. Before cultivation, soil samples were collected from the experimental site for chemical and physical analyses according to the different described methods. On October 25, 2018, various hybrids of potato tubers are being grown. By using a disc harrow and cultivator, the field was tilled three to five times. Each tilling was followed by planking to thoroughly aerate and level the soil.There were four main plot treatments which were taken as four different levels of irrigation, I_1: irrigation at 20mm Cummulative Pan Evaporimeter (CPE), I_2:irrigation at 25mm CPE, I_3:irrigation at 30mm CPE and I_4: irrigation at 30mm CPE + 5 t/ha grass mulch at planting. Five sub-plot treatments of potato hybrids were used in this experiment, which are V1: AICRP-P-21, V2: AICRP-P-32, V3: AICRP-P-37, V4: AICRP-P-38, and V5: Kufri Bahar. The crop was grown with a spacing of 60×20cm, and there were 60 plots totalling three replications, with net plot and gross plot sizes of 4.2m x 3.4m and 3.0m x 3.0m, respectively. According to the designated irrigation schedules, irrigation was carried out in furrows. Three replications of each of the 60 and 75 day crop lengths were used in the split-plot design to fully analyse the experiment. By comparing results under the different irrigation schedules, we can quantify the best suited potato hybrid for water stress on potato yield (q/ha), Nutrient (N P K) uptake by the crop, Specific gravity $(gm/cm)^3$ and soil moisture observations at different stage from different treatments.All experimental hybrids were provided same cultural practices *i.e.* fertilizer application, gap filling, earthing-up, weed management, haulm cutting and plant protection measures during whole period of investigation. The irrigation water was provided via furrow irrigation system. We can quantify the best potato hybrid for water stress on potato yield and crop nutrient uptake by comparing results under various irrigation schedules.

2.2 Properties of the Soil before the Experiment Conducted

The soil analysed was done before experimentation during 2018-2019 in which recorded available soil Nitrogen, Phosphorus and Potassium was analyzed 146 kg/ha, 18.6 kg/ha and 305.5 kg/ha. Soil pH was 7.6 and organic percentage was 0.48. Nitrogen availability is low in this field, phosphorus is medium and potassium availability is adequate. Soil pH and organic carbon is suitable for potato crop in this soil. Recommended dose of fertilizer in potato crop is 150:50:100 (N, P & K) in package practice of CCSHAU, Hisar.

The soil of the experimental field was analyzed for mechanical and chemical properties, and cropping history details are given in Table 1.

Component	Value	Method
Clay (%)	12.6	International pipette method (Piper, 1996) Piper, 1966
Silt (%)	15.5	International pipette method (Piper, 1996)
Sand (%)	71.9	International pipette method (Piper, 1996)
pH (1:2)	7.6	pH meter having glass electrode (Walkley and Black, 1934) Walkley and Black, 1934
EC (dSm^{-1} at 25^{o} C)	0.28	(Walkley and Black, 1934)
Organic carbon (%)	0.48	(Walkley and Black, 1934)
Available nitrogen (kg/ha)	146.0	Alkaline Permagnet method (Subbaiah and Asija, 1956) Subbaiah and Asija, 1956
Available phosphorus (kg/ha)	18.6	Olsen *et al.* (1954) Olsen, 1954
Available potassium (kg/ha)	305.5	Ammonia acetate method (Jackson, 1973)

Table 1: Initial fertility status of the soil (pH, Organic carbon and available N, P and K)

2.3 Growth and Parameters

2.3.1 Plant emergence

The count of plant emergence from each plot was recorded at 30 days after planting and per cent plant emergence was worked out by the following formula:

Number of tubers sprouted per plot

Plant emergence (%) = ———————————————— x 100

Total number of tubers planted per plot

2.3.2 Number of leaves per plant at 60 days after planting

For counting the number of leaves per plant, five random plants were selected and their leaves were counted at 60 days after planting separately. The average number of leaves per hill was worked out by dividing the number of leaves with number of plants and used for number of leaves at 60 days after planting.

2.3.3 Total tuber yield (q/ha)

The weight of all tuber grades (A, B, C, and D grade tubers) in each net plot was added to determine the overall yield. Different grades of tubers' weights were measured per plant, and the values were later expressed in kilogrammes per square metre and quintals per hectare.

2.3.4 Nutrient (N, P, K) uptake by the crop

Nutrient uptake by the haulms was calculated by multiplying the dry weight of haulm with nutrient contents in leaf sample and dividing by hundred and then expressed as kg/ha.

$$\text{Nutrients uptake by haulm (kg/ha)} = \frac{\text{Nutrient in haulm (\%)} \times \text{Dry Weight of haulm (kg/ha)}}{100}$$

Nutrient uptake by tuber was calculated by multiply the nutrient contents in the tuber sample with the oven dry weight of tuber and dividing them by hundred and expressed as kg per ha. Similarly, nutrient uptake by potato tuber was derived with same formula.

$$\text{Nutrients uptake by tuber (kg/ha)} = \frac{\text{Nutrient in tubers (\%)} \times \text{Dry weight of tuber (kg/ha)}}{100}$$

2.3.5 Specific gravity (g/cm)^3

Specific gravity is the weight of the tuber in air compared to the weight of the same in water. It is a measurement of density and can be calculated as follows:

$$\text{Specific Gravity SG} = \frac{\text{Weight of tubers in air}}{\text{(weight in air) - (weight in water)}}$$

2.3.6 Periodical soil moisture observations (at stolen formation, tuber initiation and bulking stage) from 0-15 cm stage-wise from different treatments

The moisture content of the soil is calculated by subtracting the weight of the dry soil from the weight of the moist soil, and then dividing by the weight of the dry soil.

$$\text{Percent moisture content (MC)} = \frac{\text{Weight of moist soil (M) - weight of dry soil (D)}}{\text{Weight of dry soil (D)}}$$

2.4 Data Analysis

The information that was gathered throughout the course of the research on a variety of parameters was subjected to statistical analysis utilising the analysis of variance method (ANOVA). To evaluate the significance of the difference in mean between two treatments, the following procedure was used to calculate the critical difference, often known as the C.D.:

C.D. = SE ×'t'

Where, S.E. is a standard error of the difference of treatment means, which was calculated as follows:

S.E. = $\sqrt{\frac{2ESM}{r}}$

C.D. : Critical difference, EMS: Error mean sum of squares, r: Number of replication.

't': Tabulated 't' value at error degrees of freedom at 5% level of significance.

3. RESULTS AND DISCUSSION

3.1 Plant emergence at 30 days after planting

Data revealed in table 2 showed that plant emergence at 30 days after planting, the effect of irrigation and hybrids was non-significant. The maximum plant emergence (97.2%) was recorded with Irrigation 25 mm CPE. Among the various means of hybrids, maximum plant emergence (96.8%) was found with P-38. Interaction effects were found non-significant. The results of the present study are in agreement with the finding that plant emergence in potato ranged from 90 to 98 per cent, however there was no effect of fertilizer treatments on plant emergence Singh *et. al.,* 2012.

3.2 Number of leaves per plant at 60 days after planting

Different irrigation levels and potato hybrids significantly affected the number of leaves per plant (Table 2). Number of leaves increased with the increase in irrigation levels. The maximum number of leaves (82.8) at 60 days after planting was recorded under irrigation level 20 mm CPE (I_1) while minimum number of leaves was observed under irrigation 30 mm CPE. Among the potato hybrids, the maximum number of leaves (74.3) was registered in hybrid P-38 at 60 days after planting respectively.

Additionally, it has been noted that drought decreased the yield of tubers by 11% to 53% Lahlou *et. al.,* 2003. In every case, the dry mass of leaves was significantly reduced by drought stress. Only the early cultivars saw a reduction in tuber numbers; the later cultivars did not. In the first three weeks of tuber bulking, cultivars that kept their tuber growth rate better under water stress also kept their yields better. There was no discernible pattern or typical response of early versus later varieties to water stress.

3.3 Total tuber yield (q/ha)

The data provided in Table 2 showed that the irrigation schedules had a significant impact on the total tuber yield of the 60 and 75 days crops, which increased significantly as irrigation level increased. The data clearly show that at irrigation level (I_1) 20 mm CPE, the total tuber yield was highest (329.6 and 457.8 q/ha). In both 60 and 75 days of crop, hybrid P-38 had the highest total tuber yield among hybrids (290.1 and 393.8 q/ha).

For 60 days crop, the interaction effect of hybrids at the same level of irrigation and irrigation at the same level of hybrid was found to be non-significant; however, for 75 days of crop, it was found to be significant. According to research, frequent irrigation increased the soil's water potential and reduced soil moisture fluctuations in the productive root zone, which increased yield Hanson *et. al.*, 1997.

3.4 Specific gravity (g/cm^3)

Data presented in table 2 showed that the specific gravity of the crop at 60 and 75 days of planting was unaffected by the irrigation schedules and was not significant .The data clearly show that at irrigation level (I1) 20 mm CPE, the specific gravity was highest (1.069 and 1.059). Hybrids are also non-significant.

The findings of the present study agreed with those of (Amer *et. al.,* 2016, Arbogast *et. al.,* 1999), who discovered that moisture deficit also has significant potential to enhance potato quality. With an increase in irrigation water volume, it was discovered that the specific gravity of potato tubers decreased Yuan *et. al.,* 2003.

3.5 Nutrient (N, P, K) uptake by the 60 and 75 days of crop

Nutrient (N, P & K) uptake by the crop

Data revealed from table 3 resulted that irrigation levels significantly affected the N, P & K uptake by the crop, which increased significantly with the increase in irrigation level. The N, P & K uptake by crop was recorded maximum under Irrigation (I_1) 20 CPE of both 60 (107.7, 183.6, and 29.68 kg ha^{-1} kg^{-1}) and 75 (122.6, 201.6 and 33.16 kg ha^{-1} kg^{-1}) days of crop respectively. Hybrids also influenced the N, P & K uptake by the crop significantly which was differ in different hybrids. Among hybrids, the maximum N, P &

K uptake by the crop P-38 was reported at 60 (108.6, 212.1 and 30.01 kg ha^{-1} kg^{-1}) and 75 (123.9, 230.1 and 34.83 kg ha^{-1} kg^{-1}) days after planting. Similarly Badr *et. al.*, 2011 in findings it has been also observed that both nitrogen rate and irrigation frequency at the shorter durations (daily, alternate and weekly) intended to stimulate the pattern of potato N uptake more than the longest duration. The total nitrogen uptake was significantly higher with (I_1) irrigation 20 mm CPE than other levels.

3.6 Periodical soil moisture observations (at stolen formation, tuber initiation and bulking stage) from 0-15 cm from different treatments.

Data presented in table 3 showed that the periodical soil moisture was significantly affected at different irrigation schedules with the irrigation level. The soil moisture was recorded maximum under Irrigation (I_1) 20 CPE in each stage *i.e.* stolen formation, tuber initiation and bulking stage (18.5, 18.2 and 18.6) respectively. Hybrids also influenced the soil moisture significantly which was differ in different hybrids., the maximum soil moisture among hybrids was registered at P-38 in each stage *i.e.* stolen formation, tuber initiation and bulking stage (15.8, 15.4 and 15.9) respectively. Soil moisture has a major effect on crop. The results of the present study are in agreement with the finding Mahmood *et. al., 2012* also reported that soil moisture content is generally higher as compared to western locations following east-to-west decreasing precipitation gradient.

Conclusion

Drought has the potential to result in substantial productivity losses in tuber yield compared to mild or moderate stress. Additionally, it may affect how efficiently nutrients are absorbed, which is essential for a high tuber yield. This study used various irrigation levels to find high-yielding potato hybrids under water stress. This study shows that it is possible to achieve high tuber growth and nutritional composition. A combination of irrigation with 30mm CPE and 5 t/ha grass mulch results in increased tuber output. As opposed to non-mulched plots, mulched plots produce higher yields and require less water for irrigation, which is advantageous for tuber growth in water-stressed or low-water vailability situations. It would be intriguing to examine in future research the effects of irrigation regimes with less severe water stress conditions in order to better understand irrigation levels, potato hybrids, and their growth.

REFERENCES

Akash, Panghal V. P. S., Bhatia A. K., Nisha, Shubham. (2023) Productive and Economic Evaluation of Potato Hybrids under Different Water Stress Conditions. *International Journal of Plant & Soil Science*, **35**(10): 174-183,

Amer, K.H., Samak, A.A. and Hatfield, J.L. (2016) Effect of irrigation method and non-uniformity of irrigation on potato performance and quality. *Journal of Water Resource and Protection*, **8**(3): 277-292.

Anonymous, 2001. FAO. The State of Food and Agriculture 2001. *Food & Agriculture Organisation*, 2001, 33.

Anonymous, 2021. Ministry of Agriculture and Farmers Welfare, Government of India. (indiastat.com)

Arbogast, M., Powelson, M.L., Cappaert, M.R. and Watrud, L. S. (1999) Response of six potato cultivars to amount of applied water and verticillium dahliae. *Phytopathology*, **89**(9): 782-788.

Badr, M.A., Taalab, A.S. and El-Tohamy, W.A. (2011). Nitrogen application rate and fertigation frequency for drip-irrigated potato (*Solanum tuberosum* L.). *Australian Journal of Basic and Applied Sciences*, **5**(7): 817-825.

Chai Q, Gan Y, Turner NC, Zhang RZ, Yang C, Niu Y, Siddique KH. (2014). Water-saving innovations in Chinese agriculture. *Advances in Agronomy*, 126:149-201.

Devi, S., Sharma, P. K., Trivedi, J., Kumar, L., Shrivastava, S. A., & Kharshan, P. G. M. (2023). Effect of different levels of NPK fertilizer on quality parameters of potato (*Solanum tuberosum* L.)

Fleisher DH, Timlin DJ, Reddy VR (2008). Elevated carbon dioxide and water stress effects on potato canopy gas exchange, water use, and productivity. *Agricultural and Forest Meteorology*, **148**(6-7):1109-1122.

Hanson, B.R., Schwanki, L.J., Schulbach, K.F. and Pettyova, G.S. (1997). A comparison of furrow, drip and sprinkler irrigation on potato yield and applied water. *Agricultural Water Management*, **33**: 139-157.

Jackson, M.L. (1973). Soil chemical analysis. Prentice Hall of India Private Limited, New Delhi, India.

Lahlou, O., Ouattar, S. and Ledent, J.F. (2003). The effect of drought and cultivar on growth parameters, yield and yield components of potato. *Agronomie*, **23**: 257-268.

Mahmood, Rezaul and Littell, Ashley and Hubbard, Kenneth and You, Jinsheng. (2012). Observed data-based assessment of relationships among soil moisture at various depths, precipitation, and temperature. *Applied Geography*, **34**: 255-264.

Nasir MW, Toth Z. (2022). Effect of drought stress on potato production: A review. Agronomy, **12**:635.

Olsen, S.R. (1954). Estimation of available phosphorus in soils by extraction with sodium bicarbonate. *United States Department of Agriculture*, No. 939.

Piper, C.S. (1966). Soil and plant analysis. Hans Publisher, Pub. Bombay. Asian Ed, 368-374.

Saenkaew HET. (2008). Inaugural address. In: Proceedings of the workshop to 182 commemorate the *International Year of Potato-2008*, Bangkok, Thailand, 6-7.

Seleiman, M.F.; Al-Suhaibani, N.; Ali, N.; Akmal, M.; Alotaibi, M.; Refay, Y.; Dindaroglu, T.; Abdul-Wajid, H.H.; Battaglia, M.L. (2021). Drought Stress Impacts on Plants and Different Approaches to Alleviate Its Adverse Effects. *Plants*, **10**, 259.

Singh, S.K. and Lal, S.S. (2012). Effect of potassium nutrition on potato yield, quality and nutrient use efficiency under varied levels of nitrogen application. *Potato Journal*, **39**(2): 155-165.

Subbaiah, B.V. and Asija, G.L. (1956). A rapid produce for determination of estimation of available nitrogen in soil. *Current Science*, **25**: 259-260.

Walkley, A.J. and Black, L.A. (1934). Estimation of soil organic carbon by the chromic acid titration method. *Soil Science*, **37**: 29-38.

Yuan, B.Z., Nishiyama, S. and Kang, Y. (2003) Effects of different irrigation regimes on the growth and yield of drip-irrigated potato. *Agricultural Water Management*, **63**(3): 153-167.

Zhai Y, Tan X, Ma X, An M, Zhao Q, Shen X, Hong J (2019). Water footprint analysis of wheat production. *Ecological Indicators*, **102**:95-102.

Ali, H., Ayub G., Elahi, E., Shahab, M., Ahmed, S. and Ahmed, N. (2015). Response of coriander (*Coriandrum sativum* L.) to different nitrogen levels and sowing dates. *Asian Journal Agriculture Biological*, **3**(4), 155-158.

Table 2: Effect of irrigation levels and potato hybrids on plant emergence, number of leaves, specific gravity and total tuber yield of 60 and 75 days crop

Irrigation levels	Plant Emergence	No. of Leaves	Specific Gravity of 60 Days crop	Specific Gravity of 75 Days crop	Tuber yield 60 days	Tuber yield 75 days
I_1	96.4	82.8	1.069	1.059	329.6	457.8
I_2	97.2	70.8	1.068	1.056	286.8	390.6
I_3	93.8	59.9	1.067	1.055	192	243.8
I_4	95.4	67.7	1.067	1.055	239.8	328.8
C.D. (5%)	N.S.	3.2	N.S	N.S	17.7	14.2
Hybrids						
V_1	94.6	66.7	1.067	1.055	243.1	319.2
V_2	96.8	74.3	1.073	1.065	290.1	393.8
V_3	95.8	69.9	1.066	1.054	259.1	349.8
V_4	95.1	68.8	1.068	1.056	250	340.9
V_5	96.1	71.9	1.064	1.052	268	372.4
C.D. (5%)	N.S.	4.1	N.S	N.S	14.1	11.7

I_1:20 mm CPE, I_2:25 mm CPE, I_3:30 mm CPE and I_4:30 mm CPE + mulch

V_1: AICRP-P-21, V_2: AICRP-P-32, V_3: AICRP-P-37, V_4: AICRP-P-38 and V_5: Kufri Bahar

Table 3: Effect of irrigation levels and potato hybrids on nutrients uptake by the crop at 60 and 75 days crop and soil moisture at different stages.

I_1:20 mm CPE, I_2:25 mm CPE, I_3:30 mm CPE and I_4:30 mm CPE + mulch

V_1: AICRP-P-21, V_2: AICRP-P-32, V_3: AICRP-P-37, V_4: AICRP-P-38 and V_5: Kufri Bahar

Irrigation levels	**Nitrogen uptake 60 days**	**Nitrogen uptake 75 days**	**Phosphorus uptake 60 days**	**Phosphorus uptake 75 days**	**Potassium uptake 60 days**	**Potassium uptake 75 days**	**Soil moisture at stolen formation**	**Soil moisture at tuber initiation**	**Soil moisture at bulking stage**
I_1	107.7	122.6	183.6	201.6	29.68	33.16	18.5	18.2	18.6
I_2	105.1	121	181.4	199.4	29	32.81	15.3	15	15.5
I_3	102.7	119.8	172	190	28.93	32.44	11.9	11.6	12.1
I_4	103.3	120.2	175.6	193.6	28.97	32.48	14.6	14.3	14.7
C.D. (5%)	0.7	0.1	0.7	0.6	0.03	0.33	0.67	0.6	0.7
Hybrids									
V_1	102.6	115.4	152.3	170.3	28.77	31.02	14.7	14.3	14.8
V_2	108.6	123.9	212.1	230.1	30.01	34.83	15.8	15.4	15.9
V_3	103.9	122.3	176.3	194.3	29	32.72	13.9	13.6	14.1
V_4	103.1	120.6	172	190	28.85	32.33	15.5	15.2	15.6
V_5	105.4	122.4	177.9	195.9	29.11	32.72	15.6	15.3	15.7
C.D. (5%)	1.9	1.1	1.1	1.1	0.07	0.08	0.47	0.4	0.5