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Performance of different varieties of potato (*Solanum tuberosum* L.) on quality parameters under water stress condition of Chhattisgarh plains

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Abstract

The present study entitled “Performance of different varieties of potato (*Solanum tuberosum* L.) on quality parameters under water stress condition of Chhattisgarh plains” was conducted during *rabi* season 2019-20 and 2020-21 under AICRP on Potato at Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G). Among the irrigation levels, the quality parameter was recorded significantly higher under I₁: (No water stress) during first and second year *i.e.* starch content per cent (20.17 and 20.10 %), dry matter content per cent (20.47 and 20.15 %) and found numerically maximum for specific gravity (1.07 and 1.07 g cm⁻³). Among varieties, the treatment V₁: (AICRP-P-59) was recorded significantly higher starch content per cent (20.70 and 20.76 %), dry matter content per cent (21.14 and 20.83 %) and recorded numerically higher for specific gravity (1.06 and 1.07 g cm⁻³) under V₄: (Kufri Pukhraj). Where, in case of interactions I₁V₁: (No water stress + AICRP-P-59) was recorded numerically higher starch content per cent (21.12 and 20.99 %), dry matter content per cent (22.00 and 21.76 %), were specific gravity (1.07 and 1.09 g cm⁻³) under I₁V₄: (No water stress + Kufri Pukhraj) and higher uniformity of tubers size, shape was found under V₁: (AICRP-P-59) and V₄: (Kufri Pukhraj) for both irrigation levels.

Keywords: Potato, water stress, irrigation, varieties, hybrids, quality

Introduction

Potato (*Solanum tuberosum* L.) having probable centre of origin is South America, where it occupies the largest area. Potato crop is highly responsive to soil, nutritional status, soil moisture availability and temperature. Available soil moisture mainly depends upon the irrigation application and precipitation occurred during the crop period. The irrigation requirement for potato varies according to the plant growth stages. The irrigation must be applied in three critical stages (Stolon formation, tuber formation and tuber development) each one of which influences growth and yield, these three stages are most critical for soil moisture availability (Begam *et al.* 2018). A few potato varieties can perform better than other cultivars under drought-prone conditions and reported promising results. Drought stress tolerance varieties have the ability to grow and display economic yield under sub-optimal water supply. The varieties tolerant to water stress would not only ensure a sustainable production but also make it more resilient to stress (Bundig *et al.* 2016) [5].

Materials and Methods

The experimental materials were conducted during *Rabi* season 2019-20 and 2020-21 under AICRP on Potato at Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G). This experiment was designed in split plot design had three replications, keeping two irrigation levels *i.e.* I₁: No water stress (6 Irrigation), I₂: Water stress (4 Irrigation) as a main plot and five different potato varieties/hybrids *i.e.* V₁: (AICRP-P-59), V₂: (AICRP-P-38), V₃: (AICRP-P-32), V₄: (Kufri Pukhraj) and V₅: (Kufri Jyoti) as sub plot treatments.

Quality parameters

The quality parameters of potato tubers *i.e.* starch content (%), dry matter content (%) of tuber, specific gravity (g cm⁻³) and uniformity of tubers size, shape are described with the help of data given in Tables 1 to 4 and shown in Fig. 1 to 3.

Starch content (%) of tuber

The data pertaining to starch content (%) of tuber were recorded at 90 days after planting and the data were presented in Table1 and depicted in Fig1.

Response of irrigation

The results observed that significantly differ among different levels of irrigation treatments during the first year, second year and pooled mean. The maximum starch content (%) of tuber was recorded under I₁ (No water stress) during first year (20.17), in second year (20.10) and pooled mean (20.14 %). However, it was similar in minimum under I₂ (Water stress) during the first year (18.94), second year (18.94) and pooled mean (18.94 %).

Response of variety

The data found that significant difference among different varieties during the first year, second year and pooled mean. The maximum starch content (%) of tuber was recorded under V₁ (AICRP-P-59) in first year, second year and pooled mean (20.70 %, 20.76 % and 20.73 %, respectively), which were found *at par* with V₅ (kufri jyoti) of (19.82 %, 19.77 %, 19.80 %) and V₄ (kufri pukhraj) of (19.61 %, 19.49 %, 19.55 %, respectively). Where, it was minimum under V₃ (AICRP-P-32) of (18.59 %, 18.50 % and 18.55 %, respectively).

Interaction (Irrigation x Variety)

The results indicated that differ non-significantly for interaction of irrigation levels and potato varieties. The interaction I₁V₁ (No water stress + AICRP-P-59) was recorded maximum starch content (%) of tuber during first year (21.12 %), in second year (20.99 %) and under pooled mean (21.06 %). However, it was minimum under I₂V₃ (Water stress + AICRP-P-32) in first year (17.79 %), under second year (17.72 %) and pooled mean (17.76 %). Starch content was significantly influenced as increasing the levels of irrigations the maximum starch content per cent of tuber was recorded under treatment I₁ (No water stress) might be due to that it provide sufficient irrigation water as requirement of crop. However, it was higher starch content per cent was recorded under variety V₁ (AICRP-P-59) as compared to other varieties. Among interactions it was showed non-significant differences of various interactions of irrigation levels and varieties. The above results are in conformity with the findings of Abubakar *et al.* (2014), Ayas and Korukcu (2010) [2] observed the maximum starch content per cent was found significantly in full irrigations. Maralian *et al.* (2014) [8] evaluated the response of different potato genotypes and irrigation levels the interaction between irrigation and genotypes, obtained the higher starch content under (V₁I₃ Clone 82-10 and 0.6 IW/CPE).

Dry matter content (%) of tuber

The data pertaining to dry matter content (%) was recorded at 90 days after planting and the data were presented in Table2 and depicted in Fig2.

Response of irrigation

The data recorded that significant difference among different levels of irrigation during the first year, second year and pooled mean. The maximum dry matter content (%) was recorded under I₁ (No water stress) during first year (20.47 %), second year (20.15 %) and pooled mean (20.31 %).

Where, it was minimum under I₂ (Water stress) during the first year (18.74 %), second year (19.02 %) and pooled mean (18.88 %, respectively).

Response of variety

The results found that significant differences among different varieties in first year, second year and pooled mean. The maximum dry matter content (%) were recorded under V₁ (AICRP-P-59) during the first year (21.14 %), second year (20.83 %) and pooled mean (20.98 %), followed by V₄ (Kufri Pukhraj) was recorded in first year (19.89 %) and pooled mean (19.95 %) and which were found *at par* with V₄ (Kufri Pukhraj) in second year (20.01 %). Where, it was minimum under V₃ (AICRP-P-32) during first year (18.28 %), in second year (18.55 %) and pooled mean (18.41 %).

Interaction (Irrigation x Variety)

The data indicated that differ non-significantly for different interaction of irrigation levels and potato varieties. However numerically higher dry matter content (%) was recorded under I₁V₁ (No water stress + AICRP-P-59) in first year (22.00 %), second year (21.76 %) and pooled mean (21.88 %). Where, it was lower under I₂V₃ (Water stress + AICRP-P-32) during first year (17.41 %), in second year (18.10 %) and pooled mean (17.76 %). Dry matter content per cent of tuber is qualitative character which differs from variety to variety and this experiment was noted significantly higher dry matter content per cent of tuber under variety (AICRP-P-59) and irrigation levels 6 irrigations (No water stress) was noted significantly higher. However, it was recorded non-significant in case of the interactions. Similar results had also been reported by Ayas and Korukcu (2010) [2] observed the maximum tuber dry matter was found statistically higher in full irrigation (100 %). Bisht *et al.* (2012) [4] reported that maximum dry matter content of tubers was recorded in I₄ (100 % Open Pan Evaporation at alternate day). Kumar *et al.* (2007) [6] found that maximum tuber dry matter content per cent was recorded under irrigation levels of 20 mm CPE.

Specific gravity (g cm²)

The data pertaining to specific gravity (g cm²) was recorded at 90 days after planting and the data were presented in Table3 and shown in Fig3.

Response of irrigation

The data found non-significant difference among different levels of irrigation treatments during the first year, second year and pooled mean. Where, numerically higher specific gravity (g cm²) was observed under I₁ (No water stress) in first year (1.07), second year (1.07) and pooled mean (1.07 g cm²). However, it was lower under I₂ (Water stress) during first year (1.06), second year (1.05) and pooled mean (1.05 g cm²).

Response of variety

The results showed that non-significantly differ among different varieties during the first year, second year and pooled mean. The maximum specific gravity (g cm²) were recorded under V₄ (Kufri pukhraj) in first year (1.06), second year (1.07) and pooled mean (1.07 g cm²). Where, it was minimum under V₅ (Kufri jyoti) during first year (1.06), in second year (1.05) and under pooled mean (1.06 g cm²).

Interaction (Irrigation x Variety)

The results observed that non-significant differences for different interaction of irrigation levels and potato varieties. The interaction I₁V₄ (No water stress + Kufri pukhraj) was observed higher specific gravity (g cm²) during the first year (1.07), second year (1.09) and pooled mean (1.08 g cm²). Where, it was lower under I₂V₅ (Water stress + Kufri Jyoti) during first year (1.05), under second year (1.04) and in pooled mean (1.05 g cm²). The specific gravity of the tubers of potato is a maturity index which is observed taking into account weight of the individual tuber weight of the water displaced by it. It was recorded that there were non-significant

difference among the tubers harvested from different irrigation regimes as well as different varieties and their interactions. It was indicated that the specific gravity of potato tuber, harvested at a particular time of maturity remains more or less same. However, irrigation at I₁ (No water stress) exhibited a higher specific gravity. This might be due to optimum moisture availability to plants. The variety V₄ (Kufri pukhraj) exceeds as compare to other varieties. These results are in agreement with earlier findings of Shock *et al.* (1992)^[9] and Lynch *et al.* (1995)^[7]. Kumar *et al.* (2007)^[6] found that non-significantly differ was recorded under irrigation levels of 15, 20, 25 and 30 mm CPE.

Table 1: Starch content (%) of tuber as influenced by different irrigation levels and varieties/hybrids of potato

Treatments	Starch content (%)		
	2019-20	2020-21	Pooled Mean
Irrigation levels			
I ₁ - No water stress (6 irrigation)	20.17	20.10	20.14
I ₂ - Water stress (4 irrigation)	18.94	18.94	18.94
SE (m) ±	0.05	0.06	0.05
CD at 5%	0.29	0.37	0.32
Varieties/hybrids			
V ₁ - AICRP-P-59	20.70	20.76	20.73
V ₂ - AICRP-P-38	19.07	19.08	19.08
V ₃ - AICRP-P-32	18.59	18.50	18.55
V ₄ - Kufri Pukhraj	19.61	19.49	19.55
V ₅ - Kufri Jyoti	19.82	19.77	19.80
SE (m) ±	0.45	0.43	0.44
CD at 5%	1.36	1.29	1.32
Interaction: (Irrigation levels X Varieties/hybrids)			
I ₁ V ₁ - No water stress (6 irrigation) + AICRP-P-59	21.12	20.99	21.06
I ₁ V ₂ - No water stress (6 irrigation) + AICRP-P-38	19.71	19.79	19.75
I ₁ V ₃ - No water stress (6 irrigation) + AICRP-P-32	19.39	19.28	19.34
I ₁ V ₄ - No water stress (6 irrigation) + Kufri Pukhraj	20.20	20.03	20.12
I ₁ V ₅ - No water stress (6 irrigation) + Kufri Jyoti	20.44	20.40	20.42
I ₂ V ₁ - Water stress (4 irrigation) + AICRP-P-59	20.28	20.52	20.40
I ₂ V ₂ - Water stress (4 irrigation) + AICRP-P-38	18.44	18.37	18.41
I ₂ V ₃ - Water stress (4 irrigation) + AICRP-P-32	17.79	17.72	17.76
I ₂ V ₄ - Water stress (4 irrigation) + Kufri Pukhraj	19.01	18.95	18.98
I ₂ V ₅ - Water stress (4 irrigation) + Kufri Jyoti	19.20	19.13	19.17
SE (m) ± Factor (B) at the same level of A	0.64	0.61	0.62
CD at 5% Factor (B) at the same level of A	NS	NS	NS
SE (m) ± Factor (A) at the same level of B	0.58	0.55	0.56
CD at 5% Factor (A) at the same level of B	NS	NS	NS

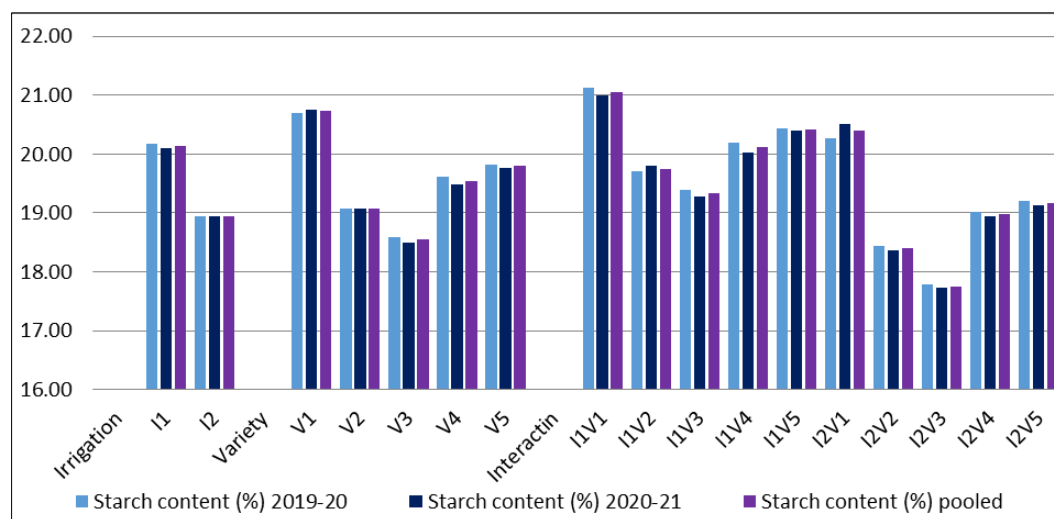


Fig 1: Starch content (%) as influenced by different irrigation levels and varieties /hybrids and their interactions of potato

Table 2: Tuber dry matter content (%) as influenced by different irrigation levels and varieties /hybrids of potato

Treatments	Tuber dry matter content (%)		
	2019-20	2020-21	Pooled Mean
Irrigation levels			
I ₁ - No water stress (6 irrigation)	20.47	20.15	20.31
I ₂ - Water stress (4 irrigation)	18.74	19.02	18.88
SE (m) ±	0.08	0.04	0.05
CD at 5%	0.50	0.27	0.32
Varieties/hybrids			
V ₁ - AICRP-P-59	21.14	20.83	20.98
V ₂ - AICRP-P-38	19.26	19.18	19.22
V ₃ - AICRP-P-32	18.28	18.55	18.41
V ₄ - Kufri Pukhraj	19.89	20.01	19.95
V ₅ - Kufri Jyoti	19.47	19.37	19.42
SE (m) ±	0.28	0.28	0.22
CD at 5%	0.85	0.83	0.67
Interaction: (Irrigation levels X Varieties/hybrids)			
I ₁ V ₁ - No water stress (6 irrigation) + AICRP-P-59	22.00	21.76	21.88
I ₁ V ₂ - No water stress (6 irrigation) + AICRP-P-38	20.11	19.71	19.91
I ₁ V ₃ - No water stress (6 irrigation) + AICRP-P-32	19.15	18.99	19.07
I ₁ V ₄ - No water stress (6 irrigation) + Kufri Pukhraj	20.74	20.39	20.56
I ₁ V ₅ - No water stress (6 irrigation) + Kufri Jyoti	20.36	19.92	20.14
I ₂ V ₁ - Water stress (4 irrigation) + AICRP-P-59	20.27	19.89	20.08
I ₂ V ₂ - Water stress (4 irrigation) + AICRP-P-38	18.40	18.65	18.53
I ₂ V ₃ - Water stress (4 irrigation) + AICRP-P-32	17.41	18.10	17.76
I ₂ V ₄ - Water stress (4 irrigation) + Kufri Pukhraj	19.04	19.63	19.34
I ₂ V ₅ - Water stress (4 irrigation) + Kufri Jyoti	18.59	18.82	18.71
SE (m) ± Factor (B) at the same level of A	0.40	0.39	0.31
CD at 5% Factor (B) at the same level of A	NS	NS	NS
SE (m) ± Factor (A) at the same level of B	0.37	0.35	0.29
CD at 5% Factor (A) at the same level of B	NS	NS	NS

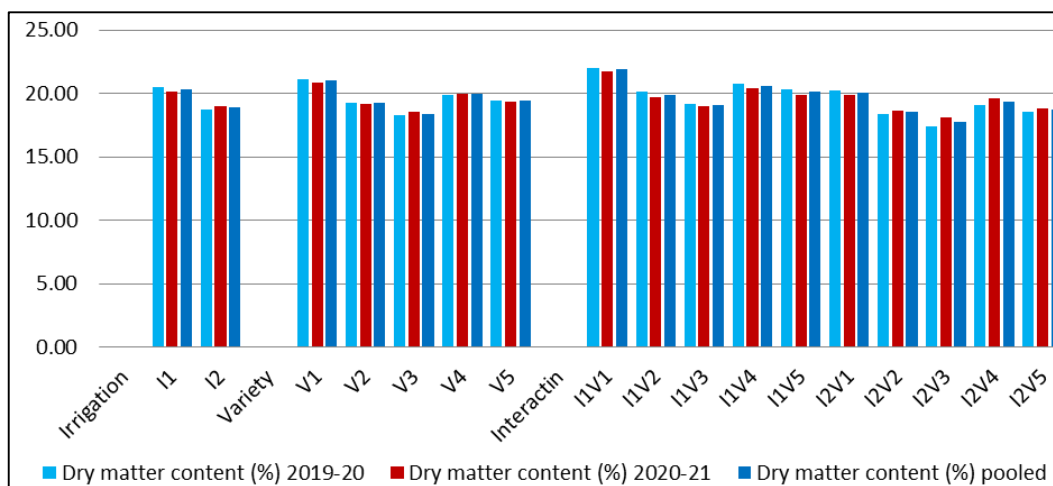


Fig 2: Tuber dry matter content (%) as influenced by different irrigation levels and varieties /hybrids and their interactions of potato

Table 3: Specific gravity (g cm²) as influenced by different irrigation levels and varieties /hybrids of potato

Treatments	Specific gravity (g cm ²)		
	2019-20	2020-21	Pooled Mean
Irrigation levels			
I ₁ - No water stress (6 irrigation)	1.07	1.07	1.07
I ₂ - Water stress (4 irrigation)	1.06	1.05	1.05
SE (m) ±	0.01	0.01	0.01
CD at 5%	NS	NS	NS
Varieties/hybrids			
V ₁ - AICRP-P-59	1.06	1.06	1.06
V ₂ - AICRP-P-38	1.06	1.06	1.06
V ₃ - AICRP-P-32	1.06	1.06	1.06
V ₄ - Kufri Pukhraj	1.06	1.07	1.07
V ₅ - Kufri Jyoti	1.06	1.05	1.06
SE (m) ±	0.01	0.01	0.01

CD at 5%	NS	NS	NS
Interaction: (Irrigation levels X Varieties/hybrids)			
I ₁ V ₁ - No water stress (6 irrigation) + AICRP-P-59	1.06	1.06	1.06
I ₁ V ₂ - No water stress (6 irrigation) + AICRP-P-38	1.05	1.06	1.06
I ₁ V ₃ - No water stress (6 irrigation) + AICRP-P-32	1.06	1.07	1.07
I ₁ V ₄ - No water stress (6 irrigation) + Kufri Pukhraj	1.07	1.09	1.08
I ₁ V ₅ - No water stress (6 irrigation) + Kufri Jyoti	1.07	1.06	1.07
I ₂ V ₁ - Water stress (4 irrigation) + AICRP-P-59	1.06	1.05	1.06
I ₂ V ₂ - Water stress (4 irrigation) + AICRP-P-38	1.07	1.05	1.06
I ₂ V ₃ - Water stress (4 irrigation) + AICRP-P-32	1.06	1.05	1.05
I ₂ V ₄ - Water stress (4 irrigation) + Kufri Pukhraj	1.06	1.05	1.05
I ₂ V ₅ - Water stress (4 irrigation) + Kufri Jyoti	1.05	1.04	1.05
SE (m) ± Factor (B) at the same level of A	0.01	0.01	0.01
CD at 5% Factor (B) at the same level of A	NS	NS	NS
SE (m) ± Factor (A) at the same level of B	0.01	0.01	0.01
CD at 5% Factor (A) at the same level of B	NS	NS	NS

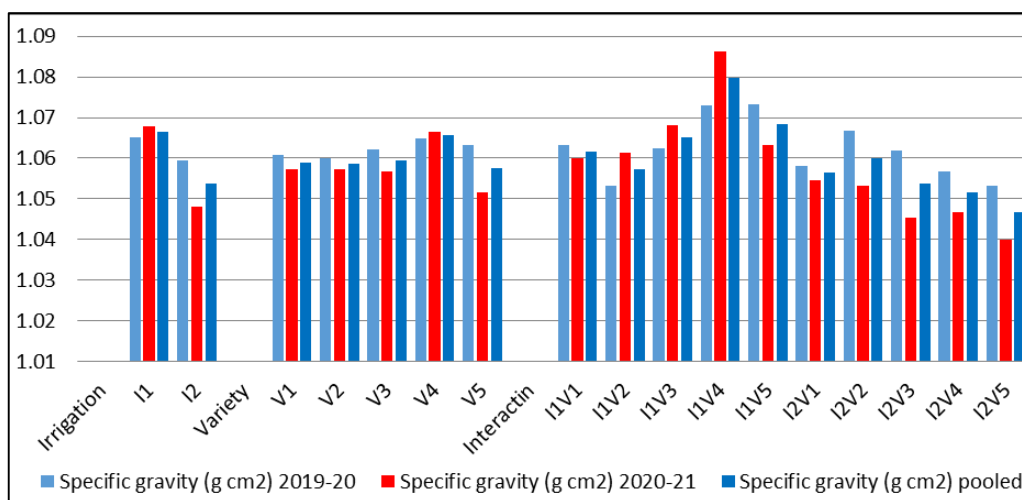


Fig 3: Specific gravity (g cm²) as influenced by different irrigation levels and varieties /hybrids and their interactions of potato

Uniformity of tubers in size and shape

The uniformity of tubers presented in Table4. Potato tuber size and shape is a desirable trait for physical quality of the potato tubers. Tuber size and shape decides its demands for ware seeds and processing potato depending upon the product specific requirements. Most of the Indian potato varieties

attain their ultimate tuber shape at maturity. The harvested potato tubers are graded according to their weight *i.e.* 0-25 g, 25-50 g, 50-75 g, >75 g. these were examined by visual identification for either Uniform (1), or Non uniform (0). The results indicated that the more uniform tubers were observed under I₁V₁, I₁V₄, I₂V₁, and I₂V₄ respectively.

Table 4: Uniformity of tubers

S. No.	Treatment	2019-20		2020-21	
		Uniform (1)	Non-uniform (0)	Uniform (1)	Non-uniform (0)
1	I ₁ V ₁	1	-	1	-
2	I ₁ V ₂	-	0	-	0
3	I ₁ V ₃	-	0	-	0
4	I ₁ V ₄	1	-	1	-
5	I ₁ V ₅	-	0	-	0
6	I ₂ V ₁	1	-	1	-
7	I ₂ V ₂	-	0	-	0
8	I ₂ V ₃	-	0	-	0
9	I ₂ V ₄	1	-	1	-
10	I ₂ V ₅	-	0	-	0

Conclusion

On the basis of this investigation the following conclusions are presented: Among the irrigation levels, the irrigation treatment I₁: (No water stress) was shown more suitable as comparison of I₂: (Water stress). Where, among varieties/hybrids, the hybrid V₁: (AICRP-P-59) was recorded maximum vigorous as compare to other varieties. However, it was more suitable interaction was I₁V₁ (No water stress +

AICRP-P-59) for different quality characteristics.

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