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Effect of water stress and different varieties/hybrids of potato (*Solanum tuberosum* L.) on yield and its attributes under Chhattisgarh plain

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Abstract
The present study entitled "Effect of water stress and different varieties/hybrids of potato (*Solanum tuberosum* L.) on yield and its attributes under Chhattisgarh plains" was conducted during *rabi* season 2019-20 and 2020-21 under AICRP on Potato at Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G). The interaction of yield parameters, were found significantly higher in first and second year under I_1V_1 (No water stress + AICRP-P-59) *i.e.* fresh weight of tuber plant^{-1} (348.77g and 361.98g), yield of tubers in different grades (t ha^{-1}) in grade 0-25g (0.97 and 0.98), 25-50g (4.22 and 4.43), 50-75g (4.42 and 5.25) and grade >75g (4.50 and 6.00), marketable tuber yield t ha^{-1} (13.14 and 15.68) and total tuber yield t ha^{-1} (15.83 and 16.85).

Keywords: Water stress, varieties, yield, potato, irrigation

Introduction
Potato (*Solanum tuberosum* L.) having probable centre of origin is South America, where it occupies the largest area. It is called as "King of vegetables". It is fourth important food crops after wheat, rice, and maize. In India, potato was introduced by the Portuguese traders or British missionaries during the 17th century and its cultivation was spread to North India by the British (Nath *et al.*, 2008, Pandey and Sarkar, 2005) [10, 12]. The major states in India growing potato are Uttar Pradesh, Punjab, West Bengal, Gujarat, Bihar, Himachal Pradesh, Maharashtra, Karnataka, Madhya Pradesh and Assam however, the leading producer state is Uttar Pradesh and maximum productivity of the crop is found in Gujarat. Water stress in potato causes considerable losses in yield, and therefore, potato is often considered to be a drought sensitive crop. Water is the most important limiting factor for potato production and it is possible to increase the production by adopting well-scheduled irrigation programs throughout the growing season (Faberio *et al.*, 2001; Panigrahi *et al.*, 2001) [7, 13].

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.* I_1: No water stress (6 Irrigation), I_2: Water stress (4 Irrigation) as a main plot and five different potato varieties/hybrids *i.e.* V_1: (AICRP-P-59), V_2: (AICRP-P-38), V_3: (AICRP-P-32), V_4: (Kufri Pukhraj) and V_5: (Kufri Jyoti) as sub plot treatments.

Results and Discussion
Yield and its attributes
The results of different yield attributes *viz.* number of tuber plant^{-1}, fresh weight of tuber plant^{-1}, dry weight of tuber plant^{-1}, yield of tubers in different grades (t ha^{-1}), marketable, unmarketable and total tuber yield (t ha^{-1}) are described below:

Number of tuber plant^{-1}
Response of irrigation
The results exhibited significant difference among different levels of irrigations, during first year, second year and in pooled mean. The data showed that maximum number of tuber plant^{-1} were recorded under I_1 (No water stress) in first year, second year and pooled mean (7.96, 6.59

and 7.28, respectively). Where, it was minimum under I_2 (Water stress) during first year, second year and pooled mean (7.13, 5.74 and 6.44, respectively).

Response of variety

The data indicated that significantly differ among different varieties during the first year, second year and pooled mean. The maximum number of tuber plant^{-1} in first year, second year and pooled mean, were recorded under V_1 (AICRP-P-59) of (8.78, 7.41 and 8.10, respectively). Followed by V_2 (AICRP-P-38) was recorded (8.00, 6.57 and 7.29, respectively). Where, it was minimum under V_4 (Kufri Pukhraj) of (6.30, 4.95 and 5.62, respectively).

Interaction (Irrigation x Variety)

The results estimated that non-significant differences for interactions of irrigation levels and potato varieties. However, numerically higher number of tuber plant^{-1} was recorded under interaction I_1V_1 (No water stress and AICRP-P-59), during first year (9.21), in second year (7.87) and in pooled mean (8.54). However, it was minimum in first year (5.92), in second year (4.56) and pooled mean (5.24), recorded under I_2V_4 (Water stress and Kufri Pukhraj). These findings are close related to Dey and Ray (2017) they found that non-significant difference for irrigation treatments but the potato variety was found significant. Kumar *et al.* (2007) [9] reported the number of tubers plant^{-1} and average tuber weight was decreased with decrease in irrigation frequency.

Fresh weight of tuber plant^{-1} (g)

Response of irrigation

The results observed significant difference among different levels of irrigation treatments during the first year, second year and in pooled mean. The maximum fresh weight of tuber plant^{-1} were recorded under I_1 (No water stress), during first year (223.96 g), in Second year (338.51 g) and under pooled mean (331.24 g). Where, it was minimum under I_2 (Water stress), in first year (277.89 g), during second year (292.77 g) and pooled mean (285.33 g).

Response of variety

The data indicated significant difference among different varieties during the first year, second year and pooled mean. The variety V_1 (AICRP-P-59) was recorded maximum fresh weight of tuber plant^{-1} in first year (315.12 g), in second year (329.17 g) and pooled mean (322.14 g). Followed by V_2 (AICRP-P-38) recorded under first year (308.95 g), during second year (323.83 g) and in pooled mean (316.39 g). Whereas, it was minimum in first year (280.64 g), in second year (295.52 g) and pooled mean (288.08 g), recorded under V_4 (Kufri Pukhraj).

Interaction (Irrigation x Variety)

The results showed the significant difference for interactions of irrigation levels and potato varieties. The interaction I_1V_1 (No water stress and AICRP-P-59), were recorded maximum fresh weight of tuber plant^{-1} during first year (348.77 g), in second year (361.98 g) and in pooled mean (355.38 g). Followed by I_1V_2 (No water stress and AICRP-P-38) recorded in first year (338.68 g), under second year (353.56 g) and under pooled mean (346.12 g). However, it was minimum in first year (274.22 g), in second year (289.10 g) and pooled mean (281.66 g), recorded under I_2V_4 (Water stress and Kufri Pukhraj). The similar results reported by Singh *et al.* (2021a), Cabello *et al.* (2012) [15, 3] reported under drought conditions, tuber yield decreased in decreasing in irrigation water to improved varieties. Where, it was significantly correlations were noted between fresh weight of tuber yield under irrigated and drought conditions.

Dry weight of tuber plant^{-1} (g)

Response of irrigation

The data showed that differ in significant among different levels of irrigation, during the first year, second year and in pooled mean. The maximum dry weight of tuber plant^{-1} was recorded under I_1 (No water stress) in first year, second year and pooled mean (41.93 g, 45.66 g and 43.79 g, respectively). Where, it was minimum under I_2 (Water stress) during the first year, second year and pooled mean (38.86 g, 42.70 g and 40.78 g, respectively).

Response of variety

The results estimated that significantly differ among different varieties in first year, second year and pooled mean. The maximum dry weight of tuber plant^{-1} during the first year, second year and pooled mean, were recorded under V_1 (AICRP-P-59) of (49.32 g, 51.01 g and 50.16 g, respectively). Followed by V_2 (AICRP-P-38) recorded (41.07 g, 44.94 g and 43.01 g, respectively). However, it was minimum under V_4 (Kufri Pukhraj) of (35.60 g, 39.80 g and 37.70 g, respectively).

Interaction (Irrigation x Variety)

The results indicated that non-significant difference for different interaction of irrigation levels and potato varieties. Numerically maximum under interaction I_1V_1 (No water stress and AICRP-P-59) dry weight of tuber plant^{-1} was recorded during the first year, second year and pooled mean (51.78 g, 53.63 g and 52.70 g, respectively). Where, it was minimum under I_2V_4 (Water stress and Kufri Pukhraj) of 35.34 g, 39.36 g and 37.35 g, respectively. Similar results have also been reported by Chaurasiya *et al.* (2016) they found that the maximum dry weight of tuber plant^{-1} was noted in (Kufri Khyati) than (AICRP-C-18).

Yield of tubers (t ha^{-1}) 0-25 g grade

Response of irrigation

The data found differ significantly among different levels of irrigation during the first year, second year and in pooled mean. The data showed maximum yield of tubers 0-25 g grade (t ha^{-1}) was recorded under I_1 (No water stress) in first year, second year and pooled mean (0.77, 0.78 and 0.77 t ha^{-1}, respectively). However, it was minimum under I_2 (Water stress) during first year, second year and pooled mean (0.65, 0.66 and 0.66 t ha^{-1}, respectively).

Response of variety

The data recorded significantly differences among different varieties in first year, second year and in pooled mean. The maximum yield of tubers 0-25g grade (t ha-^{1}) during first year, second year and pooled mean, were recorded under V_1 (AICRP-P-59) of (0.86, 0.87 and 0.86 t ha^{-1}, respectively). Followed by V_2 (AICRP-P-38) was recorded (0.75, 0.76 and 0.75 t ha^{-1}, respectively). However, it was minimum under V_4 (Kufri Pukhraj) of (0.61, 0.62 and 0.61 t ha^{-1}, respectively).

Interaction (Irrigation x Variety)

The data recorded that significant difference for different interaction of irrigation levels and potato varieties. The interaction I_1V_1 (No water stress and AICRP-P-59) was recorded maximum yield of tubers 0-25 g grade (t ha^{-1}) during the first year, second year and pooled mean (0.97, 0.98 and 0.98 t ha^{-1}, respectively). Followed by I_1V_2 (No water stress and AICRP-P-38) recorded (0.80, 0.82 and 0.81 t ha^{-1}, respectively). However, it was minimum under I_2V_4 (Water stress and Kufri Pukhraj) of (0.56, 0.58 and 0.57 t ha^{-1}, respectively). These results was closely related to the findings of Bisht *et al*. (2012) they found that the maximum yield of D-grade (0-25 g) tubers were recorded in treatment 60% OPE at alternate day.

Yield of tubers (t ha^{-1}) 25-50 g grade

Response of irrigation

The results showed significant difference among different levels of irrigation treatments during the first year, second year and pooled mean. The irrigation I_1 (No water stress) were recorded maximum yield of tubers 25-50 g grade (t ha^{-1}) during first year (3.58), second year (3.68) and pooled mean (3.63). Where, it was minimum in first year (3.09), second year (3.18) and pooled mean (3.14) respectively, under I_2 (Water stress).

Table 1: Nomber of tuber, fresh weight and dry weight of tuber plant^{-1} as influenced by different irrigation levels and varieties/hybrids of potato

Treatments	Number of tuber plant^{-1}			Fresh weight of tuber plant^{-1} (g)			Dry weight of tuber plant^{-1} (g)		
	2019-20	2020-21	Mean	2019-20	2020-21	Mean	2019-20	2020-21	Mean
Irrigation levels									
I_1- No water stress (6 irrigation)	7.96	6.59	7.28	323.96	338.51	331.24	41.93	45.66	43.79
I_2- Water stress (4 irrigation)	7.13	5.74	6.44	277.89	292.77	285.33	38.86	42.70	40.78
SE (m) ±	0.10	0.10	0.10	0.49	0.31	0.27	0.44	0.41	0.17
CD at 5%	0.63	0.61	0.62	3.01	1.86	1.63	2.70	2.51	1.05
Varieties/hybrids									
V_1- AICRP-P-59	8.78	7.41	8.10	315.12	329.17	322.14	49.32	51.01	50.16
V_2- AICRP-P-38	8.00	6.57	7.29	308.95	323.83	316.39	41.07	44.94	43.01
V_3- AICRP-P-32	7.38	6.02	6.70	302.72	317.60	310.16	39.11	43.40	41.26
V_4- Kufri Pukhraj	6.30	4.95	5.62	280.64	295.52	288.08	35.60	39.80	37.70
V_5- Kufri Jyoti	7.27	5.87	6.57	297.20	312.08	304.64	36.86	41.74	39.30
SE (m) ±	0.11	0.12	0.11	1.60	1.56	1.54	0.99	0.97	0.60
CD at 5%	0.33	0.35	0.34	4.79	4.67	4.62	2.98	2.92	1.79
Interaction: (Irrigation levels X Varieties/hybrids)									
I_1V_1- No water stress (6 irrigation) + AICRP-P-59	9.21	7.87	8.54	348.77	361.98	355.38	51.78	53.63	52.70
I_1V_2- No water stress (6 irrigation) + AICRP-P-38	8.26	6.83	7.54	338.68	353.56	346.12	43.89	46.39	45.14
I_1V_3- No water stress (6 irrigation) + AICRP-P-32	7.90	6.57	7.24	327.25	342.13	334.69	41.18	45.62	43.40
I_1V_4- No water stress (6 irrigation) + Kufri Pukhraj	6.67	5.34	6.01	287.05	301.93	294.49	35.85	40.24	38.05
I_1V_5- No water stress (6 irrigation) + Kufri Jyoti	7.75	6.35	7.05	318.07	332.94	325.51	36.94	42.42	39.68
I_2V_1- Water stress (4 irrigation) + AICRP-P-59	8.35	6.95	7.65	281.47	296.35	288.91	46.87	48.38	47.62
I_2V_2- Water stress (4 irrigation) + AICRP-P-38	7.74	6.31	7.03	279.22	294.10	286.66	38.26	43.49	40.87
I_2V_3- Water stress (4 irrigation) + AICRP-P-32	6.86	5.46	6.16	278.19	293.07	285.63	37.04	41.19	39.12
I_2V_4- Water stress (4 irrigation) + Kufri Pukhraj	5.92	4.56	5.24	274.22	289.10	281.66	35.34	39.36	37.35
I_2V_5- Water stress (4 irrigation) + Kufri Jyoti	6.79	5.39	6.09	276.33	291.21	283.77	36.78	41.06	38.92
SE (m) ± Factor (B) at the same level of A	0.15	0.17	0.16	2.26	2.20	2.18	1.41	1.38	0.85
CD at 5% Factor (B) at the same level of A	NS	NS	NS	6.77	6.60	6.53	NS	NS	2.54
SE (m) ± Factor (A) at the same level of B	0.17	0.18	0.17	2.08	1.99	1.97	1.33	1.30	0.78
CD at 5% Factor (A) at the same level of B	NS	NS	NS	6.24	5.97	5.90	NS	NS	2.33

Table 2: Yield of tubers (t ha^{-1}) in different grades as influenced by different irrigation levels and varieties/hybrids of potato

Treatments	Yield of tubers in different grades (t ha^{-1})											
	0-25g			25-50g			50-75g			>75g		
	2019-20	2020-21	Mean	2019-20	2020-21	Mean	2019-20	2020-21	Mean	2019-20	2020-21	Mean
Irrigation levels												
I_1- No water stress (6 irrigation)	0.77	0.78	0.77	3.58	3.68	3.63	3.92	4.75	4.34	4.14	5.65	4.90
I_2- Water stress (4 irrigation)	0.65	0.66	0.66	3.09	3.18	3.14	3.55	4.36	3.96	3.90	5.41	4.65
SE (m) ±	0.02	0.01	0.01	0.07	0.02	0.03	0.03	0.05	0.01	0.01	0.02	0.01
CD at 5%	0.11	0.04	0.05	0.40	0.10	0.19	0.20	0.29	0.07	0.08	0.13	0.09
Varieties/hybrids												
V_1- AICRP-P-59	0.86	0.87	0.86	3.88	4.02	3.95	4.14	4.98	4.56	4.37	5.89	5.13
V_2- AICRP-P-38	0.75	0.76	0.75	3.40	3.47	3.43	3.84	4.66	4.25	4.12	5.66	4.89
V_3- AICRP-P-32	0.68	0.69	0.69	3.23	3.34	3.28	3.68	4.50	4.09	3.98	5.46	4.72
V_4- Kufri Pukhraj	0.61	0.62	0.61	3.03	3.10	3.06	3.49	4.31	3.90	3.78	5.26	4.52
V_5- Kufri Jyoti	0.67	0.67	0.67	3.15	3.21	3.18	3.53	4.34	3.93	3.86	5.37	4.62
SE (m) ±	0.02	0.01	0.01	0.09	0.04	0.05	0.03	0.03	0.02	0.01	0.02	0.01
CD at 5%	0.05	0.03	0.03	0.26	0.12	0.14	0.10	0.10	0.06	0.04	0.05	0.03
Interaction: (Irrigation levels X Varieties/hybrids)												

I_1V_1- No water stress (6 irrigation) + AICRP-P-59	0.97	0.98	0.98	4.22	4.43	4.33	4.42	5.25	4.83	4.50	6.00	5.25
I_1V_2- No water stress (6 irrigation) + AICRP-P-38	0.80	0.82	0.81	3.55	3.63	3.59	3.92	4.76	4.34	4.25	5.85	5.05
I_1V_3- No water stress (6 irrigation) + AICRP-P-32	0.72	0.73	0.72	3.47	3.54	3.51	3.91	4.74	4.32	4.12	5.58	4.85
I_1V_4- No water stress (6 irrigation) + Kufri Pukhraj	0.65	0.67	0.66	3.22	3.30	3.26	3.66	4.49	4.07	3.85	5.33	4.59
I_1V_5- No water stress (6 irrigation) + Kufri Jyoti	0.70	0.71	0.71	3.43	3.49	3.46	3.70	4.53	4.12	4.00	5.47	4.73
I_2V_1- Water stress (4 irrigation) + AICRP-P-59	0.74	0.75	0.75	3.53	3.60	3.57	3.87	4.71	4.29	4.23	5.77	5.00
I_2V_2- Water stress (4 irrigation) + AICRP-P-38	0.69	0.70	0.69	3.24	3.31	3.28	3.76	4.56	4.16	3.99	5.47	4.73
I_2V_3- Water stress (4 irrigation) + AICRP-P-32	0.64	0.66	0.65	2.98	3.14	3.06	3.46	4.26	3.86	3.84	5.35	4.59
I_2V_4- Water stress (4 irrigation) + Kufri Pukhraj	0.56	0.58	0.57	2.84	2.91	2.87	3.32	4.12	3.72	3.70	5.18	4.44
I_2V_5- Water stress (4 irrigation) + Kufri Jyoti	0.63	0.62	0.63	2.87	2.93	2.90	3.35	4.15	3.75	3.73	5.27	4.50
SE (m) ± Factor (B) at the same level of A	0.02	0.01	0.01	0.12	0.06	0.07	0.05	0.05	0.03	0.02	0.03	0.02
CD at 5% Factor (B) at the same level of A	0.07	0.04	0.04	NS	0.17	0.20	0.14	0.14	0.08	0.05	0.08	0.05
SE (m) ± Factor (A) at the same level of B	0.03	0.01	0.02	0.13	0.05	0.07	0.05	0.06	0.03	0.02	0.03	0.02
CD at 5% Factor (A) at the same level of B	0.08	0.04	0.05	NS	0.16	0.20	0.16	0.19	0.08	0.06	0.09	0.06

Table 3: Marketable, unmarketable and total tuber yield (t ha^{-1}) as influenced by different irrigation levels and varieties/hybrids of potato

Treatments	Marketable tuber yield (t ha^{-1})			Unmarketable tuber yield (t ha^{-1})			Total tuber yield (t ha^{-1})		
	2019-20	2020-21	Mean	2019-20	2020-21	Mean	2019-20	2020-21	Mean
Irrigation levels									
I_1- No water stress (6 irrigation)	11.65	14.08	12.86	2.03	1.09	1.56	13.68	15.16	14.42
I_2- Water stress (4 irrigation)	10.54	12.95	11.75	1.61	1.34	1.48	12.15	14.29	13.22
SE (m) ±	0.07	0.04	0.02	0.02	0.05	0.02	0.08	0.05	0.03
CD at 5%	0.44	0.21	0.13	0.10	NS	NS	0.52	0.31	0.15
Varieties/hybrids									
V_1- AICRP-P-59	12.39	14.88	13.63	2.47	1.24	1.85	14.85	16.12	15.49
V_2- AICRP-P-38	11.36	13.78	12.57	2.09	1.19	1.64	13.45	14.97	14.21
V_3- AICRP-P-32	10.89	13.31	12.10	1.73	1.10	1.41	12.62	14.41	13.51
V_4- Kufri Pukhraj	10.29	12.66	11.48	1.34	1.22	1.28	11.64	13.89	12.76
V_5- Kufri Jyoti	10.54	12.92	11.73	1.49	1.32	1.40	12.03	14.24	13.14
SE (m) ±	0.14	0.06	0.08	0.01	0.03	0.02	0.14	0.07	0.07
CD at 5%	0.40	0.17	0.24	0.04	0.09	0.05	0.41	0.20	0.22
Interaction: (Irrigation levels X Varieties/hybrids)									
I_1V_1- No water stress (6 irrigation) + AICRP-P-59	13.14	15.68	14.41	2.69	1.17	1.93	15.83	16.85	16.34
I_1V_2- No water stress (6 irrigation) + AICRP-P-38	11.73	14.24	12.98	2.30	1.05	1.67	14.03	15.28	14.66
I_1V_3- No water stress (6 irrigation) + AICRP-P-32	11.51	13.86	12.68	1.96	0.98	1.47	13.47	14.84	14.15
I_1V_4- No water stress (6 irrigation) + Kufri Pukhraj	10.73	13.12	11.92	1.57	1.10	1.33	12.30	14.21	13.26
I_1V_5- No water stress (6 irrigation) + Kufri Jyoti	11.13	13.49	12.31	1.65	1.13	1.39	12.78	14.62	13.70
I_2V_1- Water stress (4 irrigation) + AICRP-P-59	11.64	14.08	12.86	2.24	1.30	1.77	13.88	15.39	14.63
I_2V_2- Water stress (4 irrigation) + AICRP-P-38	10.99	13.33	12.16	1.88	1.33	1.60	12.87	14.66	13.76
I_2V_3- Water stress (4 irrigation) + AICRP-P-32	10.28	12.75	11.52	1.49	1.23	1.36	11.77	13.98	12.87
I_2V_4- Water stress (4 irrigation) + Kufri Pukhraj	9.86	12.21	11.04	1.12	1.35	1.23	10.98	13.56	12.27
I_2V_5- Water stress (4 irrigation) + Kufri Jyoti	9.95	12.36	11.15	1.33	1.50	1.42	11.28	13.86	12.57
SE (m) ± Factor (B) at the same level of A	0.19	0.08	0.11	0.02	0.04	0.03	0.19	0.09	0.10
CD at 5% Factor (B) at the same level of A	NS	0.24	0.34	0.06	NS	0.08	NS	0.28	0.31
SE (m) ± Factor (A) at the same level of B	0.19	0.08	0.10	0.02	0.06	0.03	0.19	0.10	0.10
CD at 5% Factor (A) at the same level of B	NS	0.24	0.31	0.07	NS	0.09	NS	0.30	0.29

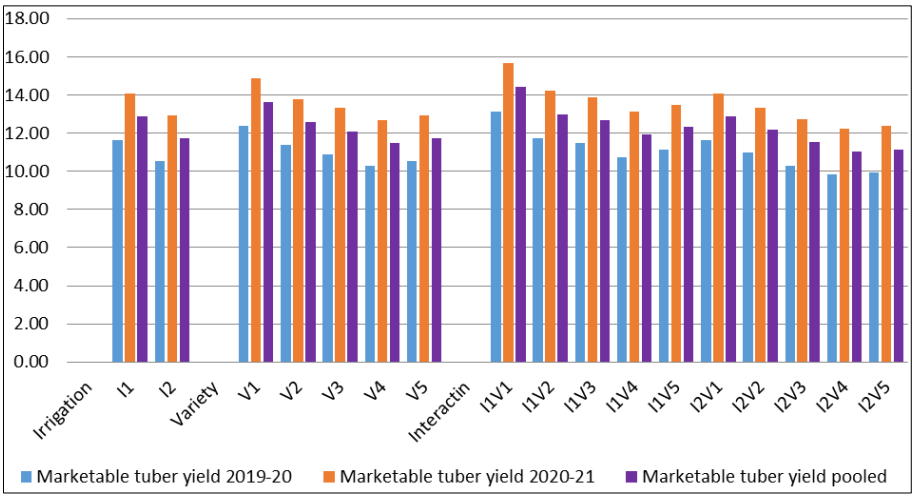

Fig 1: Marketable tuber yield (t ha^{-1}) as influenced by different irrigation levels and varieties/hybrids and their interactions of potato

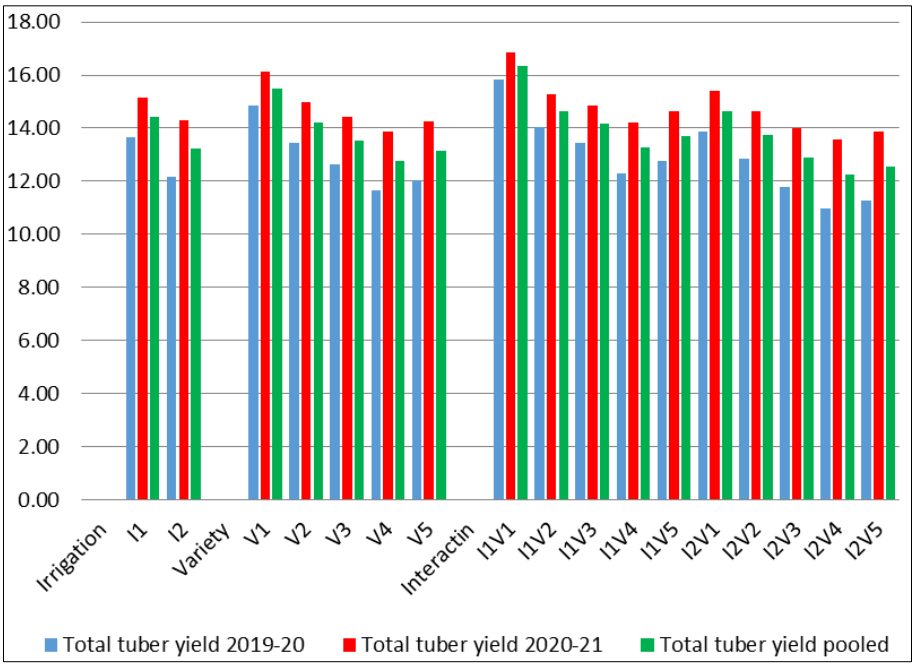

Fig 2: Total tuber yield (t ha^{-1}) as influenced by different irrigation levels and varieties/hybrids and their interactions of potato

Response of variety

The results observed that significant difference among different varieties in first year, second year and pooled mean. The variety V_1 (AICRP-P-59) were recorded maximum yield of tubers 25-50 g grade (t ha^{-1}) during first year (3.88), second year (4.02) and pooled mean (3.95). Followed by V_2 (AICRP-P-38) during first year (3.40), second year (3.47) and in pooled mean (3.43). Where, it was minimum in V_4 (Kufri Pukhraj) during first year (3.03), second year (3.10) and pooled mean (3.06).

Interaction (Irrigation x Variety)

The data recorded for interaction of there was shown that non-significant difference in first year and significant differences during second year and pooled mean. The maximum yield of tubers 25-50 g grade (t ha^{-1}) during the first year, second year and pooled mean, were recorded under I_1V_1 (No water stress and AICRP-P-59) of (4.22, 4.43 and 4.33 t ha^{-1}, respectively). Followed by I_1V_2 (No water stress and AICRP-P-38) of (3.55, 3.63 and 3.59 t ha^{-1}, respectively). However, it was minimum under I_2V_4 (Water stress and Kufri Pukhraj) at (2.84, 2.91 and 2.87 t ha^{-1}, respectively). These similar results were closely related to the findings of Begum and Saikia (2014) found that irrigation applied at critical stages recorded significantly highest tuber yield. However irrigation applied at 25 mm CPE recorded highest yield of both B-grade (50-75 g) and C-grade (25-50 g) tubers.

Yield of tubers (t ha^{-1}) 50-75 g grade

Response of irrigation

The data recorded that significantly differ among different levels of irrigation treatments during the first year, second year and pooled mean. The data showed that maximum yield of tubers 50-75 g grade (t ha^{-1}) was recorded under I_1 (No water stress) in first year, second year and pooled mean (3.92, 4.75 and 4.34 t ha^{-1}, respectively). However, it was minimum under I_2 (Water stress) during the first year, second year and pooled mean (3.55, 4.36 and 3.96 t ha^{-1}, respectively).

Response of variety

The results observed significant difference among different varieties during the first year, second year and pooled mean. The variety V_1 (AICRP-P-59) was recorded maximum yield of tubers 50-75 g grade (t ha^{-1}) during the first year, second year and pooled mean (4.14, 4.98 and 4.56 t ha^{-1}, respectively). Followed by V_2 (AICRP-P-38) recorded (3.84, 4.66 and 4.25 t ha^{-1}, respectively). Where, it was minimum under V_4 (Kufri Pukhraj) recorded (3.49, 4.31 and 3.90 t ha^{-1}, respectively).

Interaction (Irrigation x Variety)

The data found that significantly difference for different interaction of irrigation levels and potato varieties. The interaction I_1V_1 (No water stress and AICRP-P-59) was recorded maximum yield of tubers 50-75 g grade (t ha^{-1}) during the first year, second year and pooled mean (4.42, 5.25 and 4.83 t ha^{-1}, respectively). Followed by I_1V_2 (No water stress and AICRP-P-38) noted (3.92, 4.76 and 4.34 t ha^{-1}, respectively). However, it was minimum under I_2V_4 (Water stress and Kufri Pukhraj) recorded (3.32, 4.12 and 3.72 t ha^{-1}, respectively). These results was closely related to the findings of Patel *et al*. (2001) they reported that I_1 (1.0 IW/CPE) ratio recorded significantly higher yield of B grade (50-75 g) tubers over other treatment, where it was *at par* with I_2 (0.8 IW/CPE). Begum and Saikia (2014) found that irrigation applied at 25 mm CPE recorded significantly higher yield of both B-grade (50-75 g) and C-grade (25-50 g) tubers.

Yield of tubers (t ha^{-1}) >75 g grade

Response of irrigation

The results showed significant difference among different levels of irrigation treatments during the first year, second year and pooled mean. The irrigation I_1 (No water stress) was observed maximum yield of tubers >75 g grade (t ha^{-1}) during first year (4.14), second year (5.65) and pooled mean (4.90), respectively. Where, it was minimum in first year (3.90), second year (5.41) and pooled mean (4.65) respectively, under I_2 (Water stress).

Response of variety

The data recorded were differ significantly among different varieties during the first year, second year and pooled mean. The variety V_1 (AICRP-P-59) was recorded maximum yield of tubers >75 g grade (t ha^{-1}) during first year (4.37), in second year (5.89) and under pooled mean (5.13). Followed by V_2 (AICRP-P-38) during first year (4.12), second year (5.66) and in pooled mean (4.89). However, it was minimum in first year (3.78), in second year (5.26) and pooled mean (4.52), under V_4 (Kufri Pukhraj).

Interaction (Irrigation x Variety)

The results found that significant differences for interaction of irrigation levels and potato varieties. The interaction I_1V_1 (No water stress and AICRP-P-59) were recorded maximum yield of tubers >75 g grade (t ha^{-1}) during the first year, second year and pooled mean (4.50, 6.00 and 5.25, respectively). Followed by I_1V_2 (No water stress and AICRP-P-38) noted (4.25, 5.85 and 5.05, respectively). Where, it was minimum (3.70, 5.18 and 4.44, respectively) under I_2V_4 (Water stress and Kufri Pukhraj). Similar findings also been reported by Patel *et al*. (2001) they reported that I_1 (1.0 IW/CPE) ratio found higher number and yield of A-grade (>75 g) and B-grade (50-75 g) tubers over other treatment, where it was *at par* with I_2 (0.8 IW/CPE).

Marketable tuber yield (t ha^{-1})

Response of irrigation

The results showed that differ significantly among different levels of irrigation treatments during first year, second year and in pooled mean. The maximum marketable tuber yield (t ha^{-1}) was recorded under I_1 (No water stress) in first year, second year and pooled mean (11.65, 14.08 and 12.86 t ha^{-1}, respectively). Where, it was minimum under I_2 (Water stress) during the first year, second year and pooled mean (10.54, 12.95 and 11.75 t ha^{-1}, respectively).

Response of variety

The data indicated that significant difference among different varieties during the first year, second year and in pooled mean. The maximum marketable tuber yield (t ha^{-1}) during the first year, second year and pooled mean, were recorded under V_1 (AICRP-P-59) of 12.39, 14.88 and 13.63 t ha^{-1}, respectively, followed by V_2 (AICRP-P-38) of 11.36, 13.78 and 12.57 t ha^{-1}, respectively). The minimum marketable tuber yield (t ha^{-1}) was recorded under V_4 (Kufri Pukhraj) of 10.29, 12.66 and 11.48 t ha^{-1}, respectively.

Interaction (Irrigation x Variety)

The interaction data of irrigation and variety showed non-significant difference in first year and significantly differ during second year as well as pooled mean. The maximum marketable tuber yield (t ha^{-1}) during the first year, second year and pooled mean, were recorded under I_1V_1 (No water stress and AICRP-P-59) of 13.14, 15.68 and 14.41 t ha^{-1} respectively, followed by I_1V_2 (No water stress and AICRP-P-38) of 11.73, 14.24 and 12.98 t ha^{-1}, respectively. However, it was minimum under I_2V_4 (Water stress and Kufri Pukhraj) of 9.86, 12.21 and 11.04 t ha^{-1}, respectively. The results of present study confirmed the findings of Gogoi *et al.* (2020), Sadavarti *et al.* (2018). Kumar *et al*. (2007) [8, 9] they reported that the marketable tuber yield and total tuber yield decreases with decreasing in the levels of irrigations. The lower yield at higher water stress can be ascribed to reduced tuber number, tuber weight and reduce plant growth under water stress condition at 35 mm CPE.

Total tuber yield (t ha^{-1})

Response of irrigation

The data recorded significantly differ among different levels of irrigation treatments during the first year, second year and pooled mean. The data showed that maximum total tuber yield (t ha^{-1}) was recorded under I_1 (No water stress) in first year, second year and pooled mean (13.68, 15.16 and 14.42 t ha^{-1}, respectively). Where, it was minimum under I_2 (Water stress) during the first year, second year and pooled mean (12.15, 14.29 and 13.22 t ha^{-1}, respectively).

Response of variety

The results indicated that differ significantly among different varieties during the first year, second year and pooled mean. The variety V_1 (AICRP-P-59) was recorded maximum total tuber yield (t ha^{-1}) during the first year, second year and pooled mean (14.85, 16.12 and 15.49 t ha^{-1}, respectively). Followed by V_2 (AICRP-P-38) recorded (13.45, 14.97 and 14.21 t ha^{-1}, respectively). However, it was minimum (11.64, 13.89 and 12.76 t ha^{-1}, respectively), recorded under V_4 (Kufri Pukhraj).

Interaction (Irrigation x Variety)

The data was differ non-significantly in first year and significantly differ during second year as well as pooled mean for different interaction of irrigation levels and potato varieties. The maximum total tuber yield (t ha^{-1}) during the first year, second year and pooled mean, was recorded under I_1V_1 (No water stress and AICRP-P-59) of (15.83, 16.85 and 16.34 t ha^{-1}, respectively). Followed by I_1V_2 (No water stress and AICRP-P-38) of (14.03, 15.28 and 14.66 t ha^{-1}, respectively). However, it was minimum (10.98, 13.56 and 12.27 t ha^{-1}, respectively), under I_2V_4 (Water stress and Kufri Pukhraj). The similar results are in conformity with the finding reported by Gogoi *et al.* (2020) [8] found that irrigation scheduled at IW: CPE 1.25 recorded higher values for total tuber yield, harvest index and water use efficiency over other treatments. Yadav *et al.* (2003) [16] studied the effects of different irrigation level on potato cv. Kufri Sutlej; they found that highest tuber yield under 40 mm CPE.

Conclusion

The following conclusions were presented based on this study: The yield parameters like maximum number of tubers, fresh weight of tuber, dry weight of tuber $plant^{-1}$, yield of tubers in all grades, maximum marketable and total tuber yield was recorded higher under I_1V_1 (No water stress + AICRP-P-59) as comparison to other treatments. So this hybrid was shown more water stress tolerance and performed better yield and its attributes.

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