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Effect of Dehaulming on Yield and Quality of Potato (*Solanum tuberosum*)

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Abstract

Potato is one of the most important commercial crop grown worldwide covering 20 million ha cropping area. Series of cultivation practices are performed in potato cultivation where dehaulming is considered one of the prime factors that affect the quality of tubers. In the present studies dehaulming was done at 65, 70, 75, 80 and 85 days after planting. Dehaulming done at 80 and 85 days gave significant results. The quality of tubers as well as the monetary returns from these treatments was significantly high as compared to the other treatments.

Key words : Dehaulming, Potato, quality.

The Potato (*Solanum tuberosum* L.) is one of the most important food crop in the world (Braun, 2010). Potato can be cultivated in many regions of the world and used for many purposes. Potato cultivation contributes to meeting the increasing need for food created by world population growth. Potato tubers accumulate large amounts of starch and are low in fat, and their protein content is comparable to that of grains. In addition, potatoes contain vitamin C (Rodriguez Falcon *et al*., 2006). Potato is one of most important commercial crops worldwide. With a total cropping area of about 20 million hectares globally, Potato is the fourth most important staple crop after rice, wheat, and maize (Stef de Haan *et al*., 2016). The primary center of origin and diversity of potato crop is found widely prevalent in western region of South America (Hawkes,1990). The storage organ of Solanum tuberosum is tuber that is developed from the swollen underground stem, consisting of several eyes on tuber which are called buds that have potential to sprout and develop into new stem. Muthuraj *et al*. (2014) opined that the planting time and dehaulming greatly affected tuber size distribution like- large, medium and small tuber yield in a locality differently within the varieties. Haulm killing is one of the methods used in potato production that regulate tuber size and quality. Dehaulming can be used to obtain a suitable tuber size, strengthen tuber skins before harvesting leading to improvement in storage life (Struik and Wiersema, 1999). The tuber formation is much favored in short days. Among the entire cultivation practice dehaulming is considered one of the major practices that determine the qualitative and quantitative character of potato. Dehaulming is the practice in which aerial parts of a plant are removed before harvesting. Dehaulming can be done after the yellowing of aerial parts because yellowing of the plan indicates the maturity of potato. Timing of dehaulming varies according to varieties and in general, the varieties that are not disease resistant are dehaulmed earlier than the disease resistant varieties (Virtanen *et al*., 2014)

Material and methods

The present investigation was carried out at Kodit village in Purandar tahshil of Pune district

for three years (2018-19 and 2019-20. 2020-21) during *rabi* season under AICRP (Potato). In all six treatments *viz*., T_1 - Dehaulming at 65 days after planting, T_2 - Dehaulming at 70 days after planting, T_3 - Dehaulming at 75 days after planting, T_4 - Dehaulming at 80 days after planting, T_5 - Dehaulming at 85 days after planting, T_6 - Control The experiment was replicated four times in Randomised Block Design (RBD) (Panse and Sukhatme, 1985). The plant spacing was 60 x 20 cm with a plot size of 3 x 3 m, uniform fertilizers application was undertaken for all the treatments. Necessary cultural practices were also carried out uniformly for all the treatments. The manure and fertilizer were applied at the rate 20 t ha^{-1} FYM and 150: 60: 120 kg ha^{-1} N: P_2O_5 : K_2O respectively.

The observations like percent plant emergence, tuber uniformity, percent tuber dry matter percent foliage senescence, tuber yield per ha and incidence of diseases were recorded.

Results and Discussion

As dehaulming schedule treatments were started after 65 days of planting, so obviously it did not affect plant emergence as well as other growth parameters like plant height, compound leaves etc.

The significantly maximum per cent senescence (89.58%) was noticed with control treatment i.e. no dehaulming. It was followed by T_5 (Dehaulming at 85 days after planting) and it was 83.67 per cent. Significantly least senescence (7.75%) was reported in treatment with dehaulming at 65 days after planting. Around 85% foliage coverage was recorded by the main effects of date of planting, dehaulming schedule and their interaction

As dehaulming schedule treatments were started after 80 days of planting, so obviously it did not affect plant emergence as well as other growth parameters like plant height, compound leaves per hill, stem per hill and foliage coverage (%). Foliage senescence (%) was significantly influenced by date of planting. The result showed that foliage senescence % increased as the advancement of date of planting. Similar findings have also been reported by Sandhu *et al*. (2012)

The tuber uniformity is an important attribute of yield and quality. The uniformity was observed in 1 to 5 scoring scale. Different dehaulming times influenced significantly on production of uniform tubers. The treatments of dehaulming at 85 and 80 days after planting showed maximum tuber uniformity score (4.50 and 4.30 respectively). It was least (2.42, 2.58

Table 1. Plant emergence and foliage senescence as influenced by various dehaulming treatments

Treatments	Plant emergence (%)				Foliage senescence (%)			
	2019	2020	2021	Pooled mean	2019	2020	2021	Pooled mean
Dehaulming at 65 DAP	92.00	96.00	91.56	96.44	7.50 (15.85)	6.75 (15.03)	9.00 (17.44)	7.75 (16.14)
Dehaulming at 70 DAP	96.00	94.22	91.56	94.22	10.00 (18.37)	12.75 (20.88)	12.25 (20.45)	11.67 (19.94)
Dehaulming at 75 DAP	92.44	95.56	94.67	93.33	22.00 (27.91)	21.00 (27.22)	24.00 (29.29)	22.34 (28.18)
Dehaulming at 80 DAP	93.78	97.33	91.56	96.00	60.00 (50.76)	66.50 (54.62)	64.00 (53.13)	63.50 (52.83)
Dehaulming at 85 DAP	92.89	92.89	92.00	96.44	82.50 (65.26)	82.75 (65.50)	85.75 (67.80)	83.67 (66.16)
Control	95.56	92.44	93.33	95.56	88.50 (70.22)	88.00 (69.82)	92.25 (73.87)	89.58 (71.17)
SE ±	0.98	1.05	0.98	0.87	0.97	1.04	0.78	0.65
CD at 5%	NS	NS	NS	NS	2.96	3.16	2.38	1.97
CV %	2.09	2.26	2.07	1.85	5.70	6.93	7.59	6.74

and 2.59 respectively) with early dehaulming at 65 and 70 days after planting and control.

Tuber dry matter was found significantly maximum with treatment of dehaulming at 85 and 80 days after planting (17.85 and 17.74%). The significantly least (12.59%) dry matter was recorded in dehaulming at 65 days after planting treatment.

Table 2. Tuber yield (0-25g, 25-50g and 50- 75 g) as influenced by various dehaulming treatments

Treatments	Yield of tuber 0 to 25 g (t ha^{-1})				Yield of tuber 25 to 50 g (t ha^{-1})				Yield of tuber 50 to 75 g (t ha^{-1})			
	2019	2020	2021	Pooled mean	2019	2020	2021	Pooled mean	2019	2020	2021	Pooled mean
Dehaulming at 65 DAP	1.83	2.78	3.07	2.56	7.39	5.69	5.63	6.24	5.15	4.34	5.50	4.99
Dehaulming at 70 DAP	1.84	2.79	3.08	2.57	4.03	4.12	4.27	4.14	7.77	6.14	7.15	7.02
Dehaulming at 75 DAP	1.36	1.95	2.30	1.87	6.19	5.36	6.55	6.03	7.03	7.41	7.21	7.22
Dehaulming at 80 DAP	1.37	1.25	1.47	1.36	5.54	3.97	5.83	5.11	8.90	10.03	10.46	9.79
Dehaulming at 85 DAP	1.23	1.09	1.33	1.22	2.75	3.99	4.01	3.58	8.47	7.52	8.91	8.30
Control	1.00	0.92	1.08	1.00	3.16	4.22	4.44	3.94	8.21	7.41	8.38	8.00
SE ±	0.13	0.12	0.14	0.12	0.27	0.18	0.33	0.23	0.22	0.17	0.27	0.15
CD at 5%	0.40	0.37	0.44	0.37	0.84	0.56	1.02	0.72	0.69	0.54	0.82	0.46
CV %	16.41	13.74	14.25	14.80	11.44	8.12	13.18	9.89	6.02	5.01	6.84	4.06

Table 3. Yield of tubers (>75 g) and total tuber yield (t ha^{-1}) as influenced by various dehaulming treatments (Cv. K. Pukhraj)

Treatments	Yield of tuber > 75g (t ha^{-1})				Total Yield (t ha^{-1})			
	2019	2020	2021	Pooled mean	2019	2020	2021	Pooled mean
Dehaulming at 65 DAP	1.37	1.26	2.56	1.73	15.74	14.07	16.77	15.53
Dehaulming at 70 DAP	4.97	3.98	5.28	4.74	18.61	17.03	19.77	18.47
Dehaulming at 75 DAP	5.75	5.26	5.24	5.42	20.34	19.98	21.28	20.53
Dehaulming at 80 DAP	7.13	7.18	6.91	7.07	22.93	22.43	24.66	23.34
Dehaulming at 85 DAP	11.10	10.15	11.34	10.86	23.29	22.63	25.06	23.66
Control	11.52	10.16	11.09	10.92	24.14	22.81	25.51	24.15
SE ±	0.20	0.17	0.18	0.36	0.48	0.29	0.53	0.36
CD at 5%	0.62	0.53	0.54	1.08	1.48	0.88	1.62	1.08
CV %	5.90	6.54	6.10	6.56	5.80	5.94	6.82	6.18

Table 4. Tuber uniformity and tuber dry matter as influenced by various dehaulming treatments

Treatments	Tuber uniformity (1-5 scale)				Tuber dry matter (%)			
	2019	2020	2021	Pooled mean	2019	2020	2021	Pooled mean
Dehaulming at 65 DAP	2.25	2.50	2.50	2.42	12.78 (20.95)	12.13 (20.38)	12.88 (21.03)	12.59 (20.78)
Dehaulming at 70 DAP	2.50	2.75	2.50	2.58	13.38 (21.46)	14.00 (21.97)	13.30 (21.39)	13.56 (21.61)
Dehaulming at 75 DAP	3.25	3.25	3.00	3.17	15.63 (23.29)	16.63 (24.07)	15.50 (23.19)	15.92 (23.52)
Dehaulming at 80 DAP	4.25	4.50	4.25	4.34	17.88 (25.02)	18.05 (25.14)	17.30 (24.58)	17.74 (24.91)
Dehaulming at 85 DAP	4.50	4.50	4.50	4.50	17.93 (25.05)	18.1 (25.18)	17.53 (24.75)	17.85 (24.99)
Control	2.75	2.50	2.50	2.59	16.85 (24.24)	17.05 (24.39)	16.70 (24.12)	16.87 (24.25)
SE ±	0.19	0.27	0.26	0.14	0.09	0.30	0.14	0.11
CD at 5%	0.57	0.83	0.81	0.44	0.27	0.93	0.44	0.34
CV %	11.69	16.43	16.67	14.93	6.14	5.84	6.88	6.28

The dehaulming treatment had significant influence on tuber yield with different grades (tuber weight). The smallest size (0- 25 gm) tuber yield was significantly more (2.56 t ha^{-1}) with dehaulming at 65 days after planting treatment than the rest of the treatments except the treatment of dehaulming at 70 days after planting which was at par and recorded smallest tuber yield of 2.57 t ha^{-1}. This might be due to seed tuber size was more or less same. Per cent foliage coverage was not significantly influenced by 65 days after planting treatment. Similar results were reported by Kumar and Lal (2006).

The tuber (25 to 50 gm) yield was maximum (6.24 t ha) with earliest dehaulming (65 days after planting) treatment than the rest of the treatments except treatment of dehaulming at 75 days after planting (6.03 t ha) which was on par. The medium size (50 to 75 gm) tuber yield

Table 5. Per cent disease incidence in potato (cv. K. Pukhraj) at harvesting as influenced by various dehaulming treatments

Treatments	Late blight (%)				Early blight (%)				Virus (%)			
	2019	2020	2021	Pooled mean	2019	2020	2021	Pooled mean	2019	2020	2021	Pooled mean
Dehaulming at 65 DAP	0.70 (3.38)	1.80 (7.59)	0.00 (0.00)	0.83 (5.19)	12.46 (20.60)	11.07 (19.35)	9.10 (17.50)	10.87 (19.22)	0.70 (3.38)	0.35 (1.69)	0.00 (0.00)	0.35 (2.36)
Dehaulming at 70 DAP	1.42 (5.84)	2.13 (8.27)	0.69 (3.37)	1.41 (6.78)	14.22 (22.09)	12.80 (20.89)	11.95 (20.18)	12.99 (21.07)	0.71 (3.41)	0.70 (3.38)	0.69 (3.37)	0.70 (4.05)
Dehaulming at 75 DAP	3.19 (10.24)	6.50 (14.64)	1.05 (4.10)	3.58 (10.87)	16.34 (23.80)	15.14 (22.85)	12.95 (21.05)	14.80 (22.59)	1.77 (7.55)	2.51 (8.87)	1.40 (5.80)	1.89 (7.75)
Dehaulming at 80 DAP	7.42 (15.74)	9.67 (18.07)	3.82 (11.15)	6.97 (15.26)	20.44 (26.85)	18.96 (25.79)	16.35 (23.82)	18.58 (25.52)	3.18 (10.22)	3.96 (11.33)	1.73 (7.47)	2.96 (9.85)
Dehaulming at 85 DAP	10.35 (18.73)	12.86 (20.99)	6.02 (14.13)	9.75 (18.18)	23.58 (29.03)	22.17 (28.06)	19.12 (25.91)	21.62 (27.69)	5.36 (13.36)	6.06 (14.19)	3.54 (10.79)	4.99 (12.87)
Control	15.84 (23.40)	15.79 (23.39)	10.90 (19.20)	14.17 (22.10)	24.98 (29.96)	25.09 (30.04)	21.76 (27.78)	23.94 (29.28)	6.35 (14.56)	7.18 (15.49)	7.04 (15.33)	6.85 (15.16)
SE ±	1.36	0.84	1.44	0.40	0.88	0.87	0.74	0.66	1.32	1.33	1.28	0.98
CD at 5%	4.13	2.57	4.40	1.23	2.67	2.64	2.27	2.02	4.04	4.05	3.89	3.00
CV %	21.09	10.92	33.46	6.20	6.93	7.10	6.57	5.48	22.37	20.13	18.94	20.45

Table 6. Economics of potato (cv. K. Pukhraj) as influenced by various dehaulming treatments

Treatments	Yield (t ha^{-1})	Total cost of cultivation (Rs ha^{-1})	Gross income (Rs ha^{-1})	Net income (Rs ha^{-1})	B:C ratio	SYI	SVI
Dehaulming at 65 DAP	15.52	109254	186289	77034	1.70	0.52	0.35
Dehaulming at 70 DAP	18.47	116941	221622	104681	1.89	0.62	0.53
Dehaulming at 75 DAP	20.53	123494	246378	122883	1.99	0.70	0.66
Dehaulming at 80 DAP	23.34	130828	280111	149223	2.14	0.82	0.83
Dehaulming at 85 DAP	23.66	130888	283877	152989	2.16	0.83	0.84
Control	24.15	126174	241528	115353	1.91	0.85	0.61
SD	3.44	7683.72	30855.24	23573.62	0.14		
Avg.	20.95	121945.25	235415.43	113470.18	1.92		
Min.	15.52	109254.46	186288.89	77034.43	1.70		
Max.	24.15	130888	283877	152989	2.16		

SYI: Sustainability Yield Index = (Yield –SD)/Yield Max. SVI: Sustainability Value Index = (Net Income –SD)/Net Income Max
Rate of potato when dehaulmed at 65, 70, 75, 80 and 85 days: Rs 12/- per kg. Control: Rs 10/- per kg

was significantly maximum (9.79 t ha^{-1}) with the dehaulming at 80 days after planting over the rest of dehaulming treatments. The control (no dehaulming) treatment reported 8.00 t ha^{-1} medium size tuber yield.

The bigger size tuber (>75 gm) yield was found significantly maximum (10.92 mt) with control treatment than the rest of the treatments studied except the dehaulming at 85 days after planting treatment which was on par and recorded 10.86 t ha^{-1} yield of bigger size. The least big size tubers (>75 gm) was recorded with earliest dehaulming (at 65 days after planting) treatment (1.73 t ha^{-1}). The results are in agreement with Sandhu *et al*. (2012) where they reported that total and processing grade tuber yield increased significantly as the crop duration was increased from 80 to 85 days.

The total yield of tuber was significantly influenced by different dehaulming treatment. It was maximum with control than the rest of the treatments studied except the dehaulming treatments at 85 and 80 days after planting which was at par and was recorded (23.66 and 23.34 t ha^{-1} respectively). The least total tuber yield (15.53 t ha^{-1}) was recorded with dehaulming treatment at 65 days after planting. These results revealed that processing and non processing grade tubers differed due to bulking period that regulates photosynthates transferred to tubers. Significant influence of occurrence of early blight, late blight and viruses was recorded due to different dehaulming treatments. It was observed that the per cent disease incidence increased with days after planting i.e. disease built up with the plant growth. The maximum percent disease incidence of late blight (14.17%), early blight (23.94%) and viral diseases (6.85%) was observed in control treatment, while the lowest percent disease incidence of late blight (0.83%), early blight (10.87%) and viral diseases (0.35%) was observed in dehaulming at 65 days after planting.

Economics: From the data depicted in table 6, it revealed that, highest B:C ratio of 2.16 followed by 2.14 was recorded with dehaulming treatments at 85 and 80 days after planting respectively. Cost of cultivation were remained same for all the treatment combinations because date of planting and dehaulming dates did not vary any input cost and the requirement of labourers

Conclusion

It can be concluded from three years pooled data (2018-20) that dehaulming at 80-85 days after planting produced potatoes of high quality with maximum B:C ratio.

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