Himachal Journal of Agricultural Research 34 (1):34-38, 2008

Performance of potato (*Solanum tuberosum* L.) varieties for dry matter as influenced by planting seasons and fertility regimes in mid hills of Himachal Pradesh

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Abstract

Performance of four recommended varieties of potato viz., Kufri Jyoti, Kufri Giriraj, Kufri Chipsona-1 and Kufri Chipsona-2 under varied fertility regimes (3 levels of organic manure *viz.*, no FYM, 100 % recommended FYM i.e. 30t /ha and 50 % more than recommended i.e.45 t/ha and 5 levels of inorganic fertilizer *viz.*, no NPK, 25 % less NPK than recommended, 100% recommended NPK, 25 % more than recommended and 50 % more than recommended) was studied at Vegetable Research Farm of Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan (Himachal Pradesh) during spring (2001 and 2002) and autumn (2001-02 & 2002-03) seasons. Dry matter content (%) and tuber dry matter yield (kg ha^{-1}) were found to increase with increasing dose of fertilizers, and the maximum values were observed at 50 per cent more than recommended dose i.e. FYM 45 t ha^{-1}, N 180 kg ha^{-1}, P_2O_5 and K_2O at 150 kg ha^{-1} each. The highest percentage recovery of the dry matter content (22.17%) was obtained in Kufri Chipsona-2, while the overall total dry matter yield was observed in Kufri Giriraj (31.04 kg ha^{-1}) followed by Kufri Chipsona-2 (29.55 kg ha^{-1}). Similar trend was observed in different cropping seasons.

Key words: Potato, *Solanum tuberosum* L., planting seasons, cultivars, FYM, NPK.

Introduction

Potato (*Solanum tuberosum* L.) is one of the world's most efficient crops, converting land, water, labour and capital into highly nutritious food. It is native to Andes (South America). It is subtropical short day crop of plains grown in autumn/winter, while it is long day crop grown during summer in temperate regions.

Himachal Pradesh occupies an important place in potato map in India. It is being produced over an area of 12540 ha with production of 154,750 tonnes (Anonymous, 2004). It is a cash crop of mid and high hills. Due to high protein-calorie ratio and short vegetative cycle, potato yields substantially more edible energy, protein and dry matter per unit area and time than many other crops. Himachal potatoes are also well known for its chips making quality due to high recovery of dry matter and low reducing sugars.

The potato belongs to that group of vegetables, which have the highest fertilizer requirement. Potato crop needs a balanced fertilization management without which growth and development of the crop are poor and both yield and quality of tubers are affected. The response of FYM, nitrogen, phosphorus and potassic fertilizers vary considerably with variety and locality (Grewal, 1974). Fertilizer application though costly is highly economical in potato (Verma and Grewal, 1983). Therefore, the present study was undertaken to evaluate the performance of 4 recommended varieties of potato for Himachal Pradesh for processing attributes under the influence of varied levels of farm yard manure and NPK for two years during spring and autumn planting seasons.

Material and Methods

The present investigation was carried out at the Vegetable Farm(30°-51' N latitude and 77°-11' E longitude and 1260 m altitude), Department of Vegetable Crops, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan (Himachal Pradesh) during spring and autumn seasons. For autumn crop, plantings were done on 27th October, 2001 and 28th October, 2002, while for spring crop, plantings dates were 26th April, 2002 and 28th April, 2003. Treatments comprising of all possible

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combinations(60) of four varieties *viz.*, Kufri Jyoti (V_1), Kufri Giriraj (V_2), Kufri Chipsona-1 (V_3) and Kufri Chipsona-2 (V_4) with 3 levels of organic manure *viz.*, no FYM (F_1), 100 % recommended FYM i.e. 30t /ha (F_2) and 50 % more than recommended i.e.45 t/ha (F_3) and 5 levels of inorganic fertilizer *viz.*, no NPK (N_0), 25 % less NPK than recommended (N_1), 100% recommended NPK (N_2), 25% more than recommended (N_3) and 50% more than recommended (N_4), were evaluated in factorial RBD with three replications in plots of 2x2 m^2. The recommended dose of NPK was 120:100:100 kg/ha, respectively. The inorganic fertilizers were applied in the form CAN, SSP and MOP. A day before the scheduled date of planting, the large seed tubers were cut into pieces (25–30g per piece) treated with 0.25 % solution of Dithane M-45 for ten minutes against the tuber born fungal diseases. They were then dried in shade for 16 – 20 hrs and then planted in field 5 cm deep and 20 cm apart in ridges. Ridge to ridge distance was kept 60 cm. Irrigation was applied by surface channel. The different varieties of potato were harvested when haulms started drying. For estimating dry matter content, about 200-250 g potatoes from each plot were cut into smaller pieces and dried in a hot air oven at 65°C till constant weight was obtained and the percentage of tuber dry matter content was calculated over the fresh weight, while the tuber dry matter yield (kg/ha) was computed by multiplying the tuber yield per hectare with dry matter content.

Results and Discussion

Not all potatoes available in the country are suitable for processing. Selection of potato varieties as a factor determining yield of chips is very important to the processor. Processing qualities of potato depends on biochemical composition of a variety. The tuber dry matter and reducing sugar content of the potatoes are the two most important parameters in selecting raw material for processing as these determine the yield, texture and quality of processed potato products (Verma, 1991). The processing varieties should also have reasonably good yield to provide economic return to the farmers.

Tuber dry matter content (per cent)

Chips or 'crisp' is most important processed potato product. The yield of chips is prime concern to the processor, while the yield of chips is directly related to the dry matter content of the tuber.

It is evident from Table 1 that the differences among the varieties for dry matter content were statistically significant during both the years and individual seasons. The variety Kufri Chipsona-2 produced significantly highest dry matter (22.17 %) followed by Kufri Chipsona-1 (21.14), Kufri Giriraj (18.15) and lowest (17.19) was noticed in Kufri Jyoti. During spring and autumn, similar trend was observed. Kufri Chipsona-2 produced highest dry matter content (22.18 and 22.15) during autumn and spring seasons, respectively, while the minimum (17.19) was recorded by Kufri Jyoti in both seasons.

On the basis of two years investigations, it was found that different treatment combinations significantly influenced the per cent dry matter content. The highest value (19.88) related to this trait was found at T_{15} (FYM 45 t ha^{-1} N 180 kg ha^{-1}, P_2O_5 and K_2O at 150 kg ha^{-1} each) and lowest (19.49) was reported at T_1 (Control).

None of the interactions could bring any significant change in dry matter content under study in both the years. However, Kufri Chipsona-2 had maximum dry matter content both in spring as well as autumn season at T_{15} level, while minimum was observed in Kufri Jyoti at T_1 level.

Season had a significant effect on dry matter content (per cent). The highest dry matter content was registered in Kufri Chipsona-2, whereas lowest was observed in Kufri Jyoti during autumn. In general, dry matter present in all the varieties was slightly more in autumn crop than spring sown crop. These results are in conformity with the findings of Beerch *et al.* (1988), Marwaha and Sandhu (2002), and Uppal *et al.* (2002), who too reported higher dry matter in autumn sown crop.

Tuber dry matter yield (kg ha^{-1})

The dry matter yield (kg ha^{-1}) depicted significant differences among the varieties during both the years and seasons of investigations (Table 2). An inquisition of the data revealed that variety Kufri Giriraj proved to be statistically superior for dry matter yield per hectare as compared to other varieties with the maximum yield of 31.04q ha^{-1} followed by Kufri Chipsona-2 (29.55), Kufri Chipsona-1 (28.35) and minimum was noticed in Kufri Jyoti (25.87).

Table 1. Effect of season, FYM and NPK combination on tuber dry matter content (%) of potato varieties during Spring and Autumn seasons (Pooled)

Varieties/ Treatments	Spring (2001 & 02)					Autumn (2001-02 & 2002-03)					Grand Mean
	V_1	V_2	V_3	V_4	Mean	V_1	V_2	V_3	V_4	Mean	
T_1 ($F_0N_0P_0K_0$)	17.01	18.00	20.84	22.04	19.47	17.01	18.04	20.92	22.05	19.51	19.49
T_2 ($F_0N_{90}P_{75}K_{75}$)	17.02	18.06	21.03	22.06	19.54	17.03	18.05	21.07	22.06	19.55	19.55
T_3 ($F_0N_{120}P_{100}K_{100}$)	17.03	18.07	21.06	22.07	19.56	17.04	18.09	21.09	22.10	19.58	19.57
T_4 ($F_0N_{150}P_{125}K_{125}$)	17.06	18.10	21.10	22.08	19.59	17.07	18.10	21.10	22.16	19.62	19.60
T_5 ($F_0N_{180}P_{150}K_{150}$)	17.09	18.12	21.10	22.11	19.61	17.09	18.13	21.12	22.16	19.63	19.62
T_6 ($F_{30}N_0P_0K_0$)	17.03	18.07	21.07	22.08	19.56	17.05	18.08	21.10	22.09	19.58	19.57
T_7 ($F_{30}N_{90}P_{75}K_{75}$)	17.08	18.09	21.12	22.13	19.61	17.10	18.10	21.15	22.16	19.63	19.62
T_8 ($F_{30}N_{120}P_{100}K_{100}$)	17.11	18.11	21.19	22.20	19.66	17.11	18.13	21.21	22.24	19.67	19.66
T_9 ($F_{30}N_{150}P_{125}K_{125}$)	17.26	18.17	21.21	22.22	19.71	17.17	18.17	21.25	22.27	19.72	19.71
T_{10} ($F_{30}N_{180}P_{150}K_{150}$)	17.30	18.22	21.22	22.24	19.74	17.29	18.22	21.24	22.25	19.75	19.75
T_{11} ($F_{45}N_0P_0K_0$)	17.44	18.11	21.08	22.10	19.65	17.14	18.11	21.10	22.17	19.71	19.69
T_{12} ($F_{45}N_{90}P_{75}K_{75}$)	17.12	18.12	21.17	22.18	19.68	17.16	18.12	21.24	22.23	19.69	19.67
T_{13} ($F_{45}N_{120}P_{100}K_{100}$)	17.19	18.19	21.18	22.21	19.69	17.20	18.19	21.21	22.26	19.72	19.70
T_{14} ($F_{45}N_{150}P_{125}K_{125}$)	17.56	18.30	21.20	22.25	19.83	17.55	18.33	21.23	22.27	19.85	19.84
T_{15} ($F_{45}N_{180}P_{150}K_{150}$)	17.59	18.38	21.22	22.28	19.87	17.60	18.42	21.26	22.30	19.89	19.88
Mean	17.19	18.14	21.12	22.15		17.19	18.15	21.15	22.18		
Mean (V)		V_1 : 17.19			V_2 : 18.15			V_3 : 21.14		V_4 : 22.17	

	S.E.±	$CD_{0.05}$
Treatment (T)	0.012	0.024
Year (Y)	0.004	0.008
Variety (V)	0.06	0.012
T x V	0.017	NS
T x Y	0.012	NS
Y x V	0.006	NS
T x Y x V	0.034	NS

V_1 : Kufri Jyoti
V_2 : Kufri Giriraj
V_3 : Kufri Cnipsona-1
V_4 : Kufri Chipsona-2

F : FYM (t ha^{-1})
N : Nitrogen (kg ha^{-1})
P : Phosphorus (kg ha^{-1})
K : Potassium (kg ha^{-1})

Table 2. Effect of season, FYM and NPK combination on tuber dry matter yield/ha (kg ha^{-1}) of potato varieties during Spring and Autumn seasons (Pooled)

Varieties/ Treatments	Spring (2001 & 02)					Autumn (2001-02 & 2002-03)					Grand Mean
	V_1	V_2	V_3	V_4	Mean	V_1	V_2	V_3	V_4	Mean	
T_1 ($F_0N_0P_0K_0$)	18.79	21.67	19.50	20.05	20.00	19.77	25.02	20.69	21.11	21.65	20.83
T_2 ($F_0N_{90}P_{75}K_{75}$)	20.92	25.67	23.83	22.75	23.29	25.51	26.99	25.33	24.47	25.58	24.40
T_3 ($F_0N_{120}P_{100}K_{100}$)	22.67	26.99	25.53	26.25	25.11	29.37	29.82	27.66	27.74	28.65	26.88
T_4 ($F_0N_{150}P_{125}K_{125}$)	24.91	28.78	26.43	28.48	27.28	30.64	30.97	29.85	30.24	30.43	28.85
T_5 ($F_0N_{180}P_{150}K_{150}$)	25.12	29.19	27.42	29.87	27.90	31.00	32.71	32.33	33.25	32.32	30.11
T_6 ($F_{30}N_0P_0K_0$)	20.79	24.45	21.73	22.90	22.47	24.30	25.50	22.98	25.21	24.50	23.48
T_7 ($F_{30}N_{90}P_{75}K_{75}$)	22.72	25.61	26.42	26.95	25.42	25.14	29.12	29.06	30.48	28.45	26.94
T_8 ($F_{30}N_{120}P_{100}K_{100}$)	23.47	26.27	27.21	28.03	26.24	29.95	30.64	29.88	31.38	30.46	28.35
T_9 ($F_{30}N_{150}P_{125}K_{125}$)	25.32	29.04	28.27	29.93	28.39	31.06	34.01	32.52	33.64	32.81	30.60
T_{10} ($F_{30}N_{180}P_{150}K_{150}$)	25.61	29.37	29.45	30.35	28.70	31.21	36.60	34.59	35.86	34.57	31.63
T_{11} ($F_{45}N_0P_0K_0$)	22.01	27.21	29.50	23.73	24.08	24.56	29.12	23.54	24.77	25.50	24.79
T_{12} ($F_{45}N_{90}P_{75}K_{75}$)	22.92	30.84	28.78	30.17	28.18	27.55	36.00	29.76	31.80	31.27	29.73
T_{13} ($F_{45}N_{120}P_{100}K_{100}$)	24.20	34.36	29.97	31.25	29.97	29.38	40.12	33.56	36.07	34.78	32.38
T_{14} ($F_{45}N_{150}P_{125}K_{125}$)	26.32	36.70	33.22	34.52	32.69	32.07	45.91	36.34	40.33	38.67	35.68
T_{15} ($F_{45}N_{180}P_{150}K_{150}$)	26.57	36.56	33.65	35.05	32.96	32.38	45.91	36.47	40.40	38.79	35.87
Mean	23.49	28.85	27.05	27.99		28.26	33.23	29.64	31.12		
Mean (V)	V_1 : 25.87			V_2 : 31.04			V_3 : 28.35			V_4 : 29.55	

	S.E.±	$CD_{0.05}$
Treatment (T)	0.09	0.17
Year (Y)	0.03	NS
Variety (V)	0.05	0.09
T x V	0.12	0.35
T x Y	0.09	NS
Y x V	0.05	NS
T x Y x V	0.18	NS

V_1 : Kufri Jyoti
V_2 : Kufri Giriraj
V_3 : Kufri Chipsona-1
V_4 : Kufri Chipsona-2

F : FYM (t ha^{-1})
N : Nitrogen (kg ha^{-1})
P : Phosphorus (kg ha^{-1})
K : Potassium (kg ha^{-1})

Similar trend was observed in different cropping seasons. In spring and autumn pattern of dry matter yield was Kufri Giriraj (28.85 and 33.23), Kufri Chipsona-2 (27.99 and 31.12), Kufri Chipsona-1 (27.05 and 29.64) and Kufri Jyoti (23.49 and 28.26), respectively.

An examination of the data revealed that FYM and N P K influenced the dry matter yield per hectare significantly during all the years of cropping seasons. The dry matter yield increased with successive rise in treatment levels. The highest dry matter yield was observed at T_{15} level (35.87 kg/ha) followed by T_{14} (35.68 kg/ha) and minimum was recorded at T_1 (20.83 kg/ha).

In spring and autumn, highest yields (32.96 and 38.79) were observed at T_{15} level, while minimum (20.00 and 21.11) kg per hectare was found at T_1, respectively. It was observed that except single one way interaction T x V, all other interactions fail to show any significant impact on above said attribute under investigation.

This variation may be due to the inherent difference among varieties. A large variation in dry matter content of varieties was also reported earlier by Marwaha (1999), Gaur *et al.* (1999), Singh *et al.* (1999) and Peshin *et al.* (2000).

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