J Krishi Vigyan 2016, 4(2) : 28-31 DOI : 10.5958/2349-4433.2016.00007.6

Effect of Fertility Levels and Varieties on Tuber Yield and Processing Quality of French Fry Grade Potato

K S Sandhu, M S Shahi, R K Sharma and Gurbax Singh

Post Graduate Department of Agriculture, Khalsa College, Amritsar – 143002 (Punjab)

ABSTRACT

A field experiment was conducted during *rabi* seasons of 2013 to 2014, at Amritsar in split plot design having three potato varieties (Kufri Frysona, Kufri Chipsona 1 and Kufri Surya) in main plot and four fertility levels (F1; 187.5 kg N/ha [N 93.7kg (planting) + N 93.7kg (earthing)] + 62.5 kg P2O5 + 62.5 kg K2O /ha soil application; F2 ; 187.5 kg N/ha [N 84.7kg (planting) + N 84.7 kg (earthing) + 2 foliar spray (2 % urea) at 60 and 80 days after planting] + 62.5 kg P2O5 + 62.5 kg K2O /ha; F3; 270 kg N/ha [N 135 kg (planting) + N 135 kg (earthing)] + 62.5 kg P2O5 + 90 kg K2O /ha; F4; 270 kg N [N 126 kg (planting) + N 126 kg (earthing) + 2 foliar spray (2 % urea) at 60 and 80 days after planting] + 62.5 kg P2O5 + 90 K2O kg/ha.) in sub plots with three replications. French fry grade (FFG) tuber yield was significantly higher in F_1 than F_3, F_4 and F_2. Tuber dry matter and French fry color were in highly acceptable range throughout the fertility treatments. Significantly more number of Chip grade (45-75mm), processing grade (>45mm), total and French fry grade tubers (>75mm) were noticed in Kufri Chipsona 1 and Kufri Surya, respectively. Kufri Surya and Kufri Frysona produced significantly higher FFG tuber yield, whereas chip grade tuber yield was significantly highest in Kufri Chipsona1 (18.8 t/ha). Tuber dry matter was significantly higher in Kufri Frysona and Kufri Chipsona1 than Kufri Surya.

Key Words: Processing, Varieties, Nitrogen levels, French fry grade tubers, Processing attributes.

INTRODUCTION

Processing of potato is gaining momentum at faster pace in India since last decade because of development of processing varieties, and their production and storage technologies (Kumar *et al* 2011). Potato chips and French fries are the major processed products in India. Unlike the popularity of chips among children, freshly fried French fries are most common convenience food of people of all age groups. Huge growth in the requirement of French fries from 2,500 MT in 2005-06 to 24,000 MT in 2010-11 attracted some Indian companies to undertake French fry production venture but soon they felt handicapped due to non-availability of sufficient quantities of good size French fry quality potatoes. Processing of potatoes into French fry requires certain minimum quality attributes that include oblong to long tubers (preferably more than 75 mm size) with shallow eyes, low peeling losses, low reducing sugars (200 mg/100 g fresh tuber weight) and more than 20 per cent tuber dry matter for crispy and light colored French fries (Marwaha, 1997). Important factors influencing French fry grade as well as total tuber yield are nutrient management and choice of cultivars. Enhanced application of N and K in Kufri Chipsona 1 and Kufri Chipsona 2 improved the both processing quality and yield (Kumar *et al* 2007 a,b). Therefore, first Indian processing variety Kufri Chipsona 1, first heat tolerant and suitable for early planting variety Kufri Surya and first high yielding variety for French fries Kufri Frysona were evaluated for maximum French fry grade tuber production under different fertility levels at Amritsar.

MATERIALS AND METHODS

The field experiment was conducted on sandy loam soil (Typic Ustochrept) during *rabi* seasons of 2013 to 2014 at Students' Farm, Khalsa College, Amritsar, India (74° 55' N, 31° 37' N, 236 m above

Corresponding Author's Email: kanwaljit74@gmail.com

mean sea level) in split-plot design with three replications. The main plot treatments consisted of three potato varieties with long tubers (Kufri Frysona, Kufri Chipsona 1 and Kufri Surya), while sub-plots consisted of four fertilizer management treatments (F1; 187.5 kg N/ha [N 93.7kg (planting) + N 93.7kg (earthing)] + 62.5 kg P2O5 + 62.5 kg K2O /ha soil application; F2 ; 187.5 kg N/ha [N 84.7kg (planting) + N 84.7 kg (earthing) + 2 foliar spray (2 % urea) at 60 and 80 days after planting] + 62.5 kg P2O5 + 62.5 kg K2O /ha; F3; 270 kg N/ha [N 135 kg (planting) + N 135 kg (earthing)] + 62.5 kg P2O5 + 90 kg K2O /ha; F4; 270 N kg [N 126 kg (planting) + N 126 kg (earthing) + 2 foliar spray (2 % urea) at 60 and 80 days after planting] + 62.5 kg P2O5 + 90 K2O kg/ha.) in sub plots with three replications. The inter-row spacing was kept 67.5 cm with intra-row spacing of 25 cm. Chemical analysis of the soil (0-15 cm) showed neutral pH (7.05), low organic carbon content (0.31%) and low alkaline $KMnO_4$-N (157.4 kg/ha), high Olsen's (0.5 M $NaHCO_3$ extractable) P (29.6 kg/ha) and medium 1N ammonium acetate extractable K (146.8 kg/ha). Half N (as per treatment), full P and full K (as per treatment) were applied at the time of planting as band placement. The remaining half N (as per treatment) was applied in soil at the time of earthing up (25 days after planting) as band placement. In two treatments (F_2 and F_4), foliar spray of urea (2%) was also done at 60 and 80 days after planting (DAP) with the view to extend the maturity period to have higher French fry grade tuber number and yield. Nitrogen was applied through calcium ammonium nitrate at the time of planting and through urea at earthing up. Phosphorus and potash were applied through diammonium phosphate and muriate of potash, respectively. The experimental crop was planted on 2nd and 4th October during 2013 and 2014, respectively. Well-sprouted seed tubers (weighing 50-60 g and about 40-45 mm in size) were planted in plots of 4.05×4 m size. The experimental crop was raised under assured irrigation using the furrow method. Dehaulming was done manually at 100 DAP and harvesting was done two weeks later after skin setting. Total, French fry grade (> 75 mm), chip grade (45-75 mm) and small (<45 mm) tuber number and yield were recorded at harvest from the whole produce of the plot. To estimate tuber dry matter content five French fry grade tubers from each plot were chopped in fine pieces and 50 g sample was oven dried at 80 °C till constant weight was achieved (Kumar *et al* 2007a).

At harvest five French fry size tubers were selected randomly from each plot and used for determining French fry colour score. Potato fries were prepared at laboratory scale which involved peeling of tubers in abrasive peeler, cutting into 1×1cm thick French fries using manual French fry cutter, washing and drying on paper towel. Dried fries were then fried in refined sunflower oil in a thermostatically controlled deep fat fryer at 180 °C till 5 min. Fries were evaluated for fry colour on a scale of 1-10, subjectively with the help of colour cards (Ezekiel *et al* 2003), where scale 1 represents white fries, free from any browning and of highly acceptable colour while 10 is brown and unacceptable colour. The fries with colour range of 1 to 3 were considered acceptable. Data of each character collected from the experiments were statistically analyzed using standard procedures of variance analysis with the help of statistical software IRRISTAT (IRRI, 199).

RESULTS AND DISCUSSION

Tuber Number

Except French fry grade, there was no significant variation in chip grade, total processing grade, small and total tuber yield under different fertility levels (Table 1). Maximum and significantly higher French fry grade tubers were noticed in F_1 than F_3, F_4 and F_2 which were statistically at par with each other. On the other hand, F_4 produced slightly higher number of chip grade, processing grade, small and total tubers than others three treatments. Most suitable fertility treatment for French fry grade and chip grade tubers were F_1 and F_4, respectively. An increase in number of tubers by N fertilization

Table 1. Effect of fertilizer management and varieties on growth and graded tuber number of potato (Pooled data of two years)

Treatment	Emergence (%)	Tuber number (thousand/ha)				
		French fry grade (>75 mm)	Chip grade (45-75 mm)	Processing Grade (>45 mm)	Small (<45 mm)	Total
Fertilizer Management						
F_1	94.5	99.0	200.3	299.3	169.3	468.6
F_2	94.9	81.0	218.2	299.2	164.5	463.7
F_3	95.1	87.3	202.8	290.1	161.1	451.2
F_4	94.9	82.1	225.6	307.7	171.3	478.9
SEm±	0.6	4.4	10.1	11.1	10.4	18.0
CD (0.05)	NS	13.0	NS	NS	NS	NS
Varieties						
Kufri Frysona	94.2	92.7	203.1	295.8	169.1	464.9
Kufri Chipsona 1	95.2	58.6	263.7	322.3	199.3	521.6
Kufri Surya	94.7	110.6	168.5	279.1	131.2	410.3
SEm±	0.5	7.2	5.5	8.8	7.7	16.0
CD (0.05)	NS	28.4	21.5	34.3	30.2	63.2

has also been on record (Kumar *et al* 2007a) and (Kumar *et al* 2012).

Among varieties, Kufri Surya and Kufri Chipsona 1 produced maximum and significantly higher French fry grade and chip grade tubers than other verities, respectively. Kufri Chipsona 1 gave significantly higher processing grade, small and total tuber number than Kufri Surya (Table 1). This variation in tuber setting among varieties may be ascribed to their genetic makeup (Horton, 1987).

Tuber yield

Different fertility levels did not show significant change in tuber yield recorded under different size categories. Except chip grade tubers, yield of all others categories was slightly higher in F_1 (Table 2). Nitrogen application at the rate of 187.5 kg/ha seems to be sufficient to potato crop throughout the growing period leaving no scope for improvement of tuber yield under different categories either by higher rate or by foliar spray of nitrogen. These results corroborate the findings of Kumar *et al* (2007a) and Kumar *et al* (2012).

Kufri Surya being at par with Kufri Frysona gave significantly higher French fry grade (FFG) tuber yield than Kufri Chipsona 1, whereas, significantly highest chip grade as well as small tuber yield was recorded in Kufri Chipsona 1 (Table 2). Total processing and total tuber yield was also slightly higher in Kufri Chipsona-1 than other varieties. Singh *et al* (2010) observed similar variation among different genotypes.

Processing quality

Tuber dry matter is an important parameter from processing point of view because it determines the recovery of final fried products. Tuber dry matter was slightly higher in treatment F_4 (21.2%) than other three fertility level (Table 2) whereas, variety Kufri Frysona exhibited significantly more tuber dry matter (23.1%) than Kufri Chipsona 1 (21.8%) and Kufri Surya (17.8%) which may be ascribed to their genetic make-up (Kumar and Kang, 1998). Tuber dry matter content already reported to be significantly influenced by nitrogen levels (Kumar *et al* 2007a) as well as varieties (Kumar *et al* 2007b).

Table 2. Effect of fertilizer management and varieties on graded tuber yield and processing quality of potato at harvest (Pooled data of two years)

Treatment	Tuber yield (t/ha)					Tuber dry matter (%)	French fry colour
	French fry grade (>75 mm)	Chip grade (45-75 mm)	Process-ing grade (>45 mm)	Small (<45 mm)	Total		
Fertilizer management							
F_1	12.35	14.21	26.56	4.22	30.78	21.0	1.84
F_2	11.13	15.04	26.17	3.92	30.08	20.3	1.80
F_3	11.97	14.32	26.29	3.91	30.20	21.0	1.78
F_4	10.90	15.53	26.43	3.81	30.23	21.2	2.01
SEm±	0.57	13.85	0.76	0.25	0.89	0.55	0.17
CD (0.05)	NS	NS	NS	NS	NS	NS	NS
Varieties							
Kufri Frysona	12.60	13.85	26.46	3.99	30.45	23.1	1.88
Kufri Chipsona-1	7.70	18.79	26.49	4.79	31.28	21.8	1.82
Kufri Surya	14.45	11.67	26.12	3.11	29.24	17.8	1.81
SEm±	0.92	0.50	0.80	0.13	0.89	0.42	0.17
CD (0.05)	3.62	1.95	NS	0.53	NS	1.67	NS

French fry colour did not show significant variation and was, in highly acceptable colour range (<3CCS) throughout the fertility levels (Kumar *et al* 2007a) and varieties (Table 2).

CONCLUSION

It was concluded that fertility treatment F_1 was suitable for the production of higher FFG, TPG and total tuber yield. Among varieties Kufri Frysona, Kufri Surya and Kufri Chipson 1 were suitable for FFG and Chip grade tubers with acceptable processing attributes, respectively.

REFERENCES

Ezekiel R, Singh Brajesh and Kumar Dinesh (2003). A reference chart for Potato chip color for use in India. *Journal of Indian Potato Association* ***30*** (3, 4): 259-265.

Horton D (1987). Potatoes: Production, Marketing and programs for developing countries. *IT Publications, London,* U.K. pp. 36-47.

IRRI (1991). IRRISTAT for windows version 4.0 Biometrics Unit, IRRI, Los Banos, Philippines

Kumar P, Pandey S K, Singh B P, Singh S V and Kumar D (2007a). Effect of nitrogen rate on growth, yield, economics and crisp quality of Indian potato processing cultivars. *Potato Research* **50** (20): 143-155.

Kumar P, Pandey S K, Singh B P, Singh S V and Kumar D (2007b). Influence of source and time of potassium application on potato growth, yield, economics and crisp quality, *Potato Research* **50** (1): 1-13.

Kumar Parveen, Pandey S K, Singh S V, Kumar Dinesh, Singh B P, Singh Sukhwinder, Rawal S and Meena R L (2012). Influence of N and K rates on yield and quality of chipping variety Kufri Chipsona-3. *Potato Journal* **39** (2) : 191-196.

Kumar Parveen, Pandey S K, Singh S V, Kumar Dinesh, Singh B P, Singh Kapur, Rawal S and Singh Sukhwinder (2011). Effect of growth duration, N application and row spacing on productivity, profitability and processing quality of potato. *Potato Journal* **38** (2) : 137-142.

Marwaha R S (1997). Processing of potatoes: current status, need, future potential and suitability of Indian varieties - A critical appraisal. *Journal of Food Science and Technology* **34**: 457-471.

Singh S V, Pandey S K, Kumar Dinesh, Marwaha R S, Manivel P, Kumar Parveen, Singh B P, and Bhardwaj Viney (2010). Kufri Frysona: First high yielding potato variety for French fries in India. *Potato Journal* **37** (3,4): 103-109.

Received on 22/01/2016 Accepted on 26/04/2016