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# KUFRI JAMUNIA: A PURPLE FLESHED BIOFORTIFIED POTATO VARIETY

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**ABSTRACT: Kufri Jamunia, is a table purpose purple fleshed main season potato variety recommended for cultivation in North Indian plains (Northern, Central and Eastern Plains). It is a clonal selection developed from the cross between MS/8-1148 × CP4242. Its plants are medium tall with medium maturity and produce dark purple oblong tubers with shallow eyes, purple flesh and mealy texture. The variety is capable of producing a total tuber yield of 32-35 t/ha. Kufri Jamunia possesses medium dormancy of 6-8 weeks with very good keeping quality and moderate tuber dry matter of 17-19%. It is moderately resistant to late blight under laboratory conditions; however, it was found susceptible in field conditions. Owing to its purple colour and good organoleptic taste, the variety will attract growers, traders and consumers, adding novelty in the preparation of various dishes.**

**KEYWORDS:** Kufri Jamunia, purple skin, purple flesh, antioxidant, high yield, keeping quality, North Indian plains.

## INTRODUCTION

Potato is one of the predominant non-grain, starchy, readily available energy-rich, important tuber crop in terms of food and nutritional security. The preference for red skin potatoes had been region specific, but now the era of coloured potato varieties like red, purple, and blue fleshed has started, offering both nutritional and visual appeal. Pigmented potato cultivars offer numerous health-promoting phytonutrients and an excellent matrix for developing functional foods and nutraceuticals (Ezekiel *et al*., 2013). Apart from the high-yielding varieties, few native pigmented potato landraces are traditionally grown in the North-Eastern and Terai agro-ecological regions of India. The production scale of these pigmented landraces is small and regional to date and their predominant uses are in culinary applications due to their special taste and appearance (Kumar *et al*., 2024). In Bihar, red-skinned potatoes are favored over white-skinned varieties due to culinary practices that utilize potato varieties suitable for "bhujia" (fried sabzi) preparation (Yadav *et al*., 2024). These coloured potatoes contain high levels of anthocyanins and carotenoids, natural pigments that render them distinct hues of red, purple and yellow (Luthra *et al*., 2018). In addition, the coloured potatoes are also enriched with micronutrients such as iron and zinc, which are typically found in lower concentrations in white/yellow fleshed varieties. Over the past decades, consumers have become more interested in nutritious food fortified with micronutrients

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and antioxidants, driven by the increasing awareness of health benefits. However, shifts in preferences vary according to region, taste, and availability. For instance, people of eastern India and J&K have their inclination towards red skinned potatoes, while, Bareilly red variety of potato, distinguished with dark red tubers, variegated flesh colour is prominent in Bareilly district of Uttar Pradesh (Luthra, 2015). Also, purple or purple-black varieties locally grown in some pockets of Himachal Pradesh and North eastern regions are being favored owing to their slow degeneration rate and better taste (Luthra *et al*., 2020a). In this regard, ICAR-CPRI has so far developed ten indigenous varieties with red skin and white or white-cream flesh colour and as well as two purple-skinned varieties: Kufri Neelkanth with yellow flesh colour (Luthra *et al.*, 2020b) and Kufri Jamunia with purple skin as well as purple flesh (Luthra *et al.*, 2025). Therefore, taking into account the preferences of consumers supplementing with nutrient rich fortified foods, the efforts were directed to develop a new coloured antioxidant and micronutrient rich variety, having good keeping quality with purple skinned tubers with purple flesh colour. The work in this respect led to the development of a new specialty potato variety Kufri Jamunia.

## BACKGROUND

The advanced clone MSP/16-307 was developed from the cross between MS/8-1148 × CP4242 made in 2015 at Modipuram. The clone MSP/16-307 was selected in 2016 from the seedling stage and since then, it has passed successfully through various clonal generation trials. It was evaluated in a preliminary (2018-19) and two confirmatory yield trials (2019-20 and 2020-21) at Modipuram followed by multi-location replicated trials under AICRP (Potato) during 2021-22 and 2022-23 (15 locations) in North Indian plains comprising northern, central and eastern plains. The pedigree of Kufri Jamunia is described in Figure 1. The female parent MS/8-1148 is an indigenous advanced clone with medium maturity, high yield, moderate resistance to late blight, good keeping quality and rich in ascorbic acid (vitamin C) content (Luthra *et al.*, 2021). It produces attractive, medium sized 8-10 light yellow ovoid tubers with shallow eyes and yellow flesh colour. The male parent CP4242 produces dark purple oblong tubers with shallow eyes and purple flesh colour. The data was analyzed following standard statistical procedures using the online statistical software OPSTAT, CCS HAU, Hisar, Haryana (Sheoran *et al,* 1998). Based on its performance, the advanced clone was recommended for release by the 41st Group Meeting of AICRP (Potato) held during October 16-18, 2023 at CCS HAU, Hissar, Haryana and subsequently it has been released and notified as variety in the name of Kufri Jamunia in the 31st meeting held on 19th July, 2024 by Central Sub-Committee on Crop Standards Notification and Release of Varieties for Horticultural Crops, Ministry of Agriculture, Department of Agriculture and Co-operation, Government of India, New Delhi vide F.No. No.3-76/2024-SD-lV dated 23rd September, 2024 and Official Gazette S.O. 4917(E dated 13th November, 2024

## VARIETAL DESCRIPTION

**Plants:** Morphological characteristics of variety Kufri Jamunia (leaf, flower, sprout and tuber) have been depicted in Figure 2.

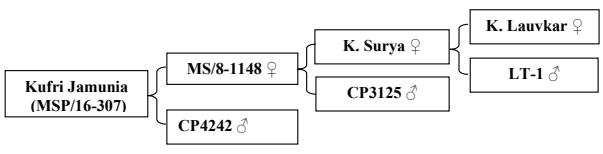


*Fig. 1. Pedigree of Kufri Jamunia*

*Fig. 2. Morphological characteristics of Kufri Jamunia: Leaf, flower, tuber and sprout*

**Plant:** Medium, plant canopy semi-compact, stem medium thick, predominantly green, secondary stem colour purple throughout lightly scattered, wings poorly developed and wavy.

**Foliage:** Grey green, leaves intermediate, leaf large with medium width, leaflets ovate lanceolate, leaflet coalescence absent, rachis coloured, midrib coloured only at base.

## Inflorescence

**Flower:** Flowering medium, inflorescence medium, floral stalk medium coloured, floral stalk-pedicle articulation clearly visible and located above the middle, calyx light purple, corolla white, corolla shape semi-stellate, anther orange black stripped, anther cone normally developed, stylar length equal than stamen column and stigma round.

## Tubers

***Size***: Medium to large, 10-12 tubers per plant; **Shape**: oblong; **Skin**: dark purple; **Eyes**: shallow; **Eyebrows**: normal; **Flesh**: purple having mealy texture.

## Sprout

Sprout purple, shape cylindrical, pubescence at the sprout base is weak

## YIELD PERFORMANCE

## Station trials at Modipuram, Meerut

In station trials at Modipuram (2018-19, 2019-20, 2020-21 (Table 1), the advanced clone

**Table 1. Performance of MSP/16-307 at Modipuram during 2018-19 to 2020-21**

| Genotypes | Total tuber yield (t/ha) | | | | | | | Yield increase (%) over controls | |
|---|---|---|---|---|---|---|---|---|---|
| | 2018-19 | | 2019-20 | | 2020-21 | | Mean | | |
| | 90 days | 75 days | 90 days | 75 days | 90 days | 75 days | 90 days | 75 days | 90 days |
| MSP/16-307 | 47.04 | 33.49 | 54.06 | 35.67 | 45.93 | 34.58 | 49.01 | | |
| Kufri Lalima | 51.98 | 34.48 | 41.68 | 37.01 | 46.77 | 35.75 | 46.81 | -3.26 | 4.70 |
| Kufri Lalit | 48.83 | 30.16 | 43.66 | 36.25 | 44.41 | 33.21 | 45.63 | 4.14 | 7.40 |
| Kufri Neelkanth | 47.02 | 35.35 | 45.24 | 39.44 | 50.13 | 37.40 | 47.46 | -7.53 | 3.26 |
| CD (0.05) | 1.95 | 1.62 | 2.23 | 2.42 | 2.20 | 2.02 | 2.13 | | |
| | Marketable tuber yield (t/ha) | | | | | | | | |
| MSP/16-307 | 45.64 | 28.55 | 48.90 | 33.74 | 43.57 | 31.15 | 46.04 | | |
| Kufri Lalima | 48.95 | 31.89 | 38.04 | 35.66 | 44.72 | 33.78 | 43.90 | -7.79 | 4.86 |
| Kufri Lalit | 46.91 | 27.76 | 40.20 | 34.58 | 42.62 | 31.17 | 43.24 | -0.08 | 6.46 |
| Kufri Neelkanth | 41.63 | 31.45 | 40.10 | 37.12 | 46.17 | 34.29 | 42.63 | -9.16 | 7.98 |
| CD (0.05) | 2.05 | 1.76 | 2.91 | 2.30 | 2.36 | 2.03 | 2.44 | | |

MSP/16-307 (34.58 t/ha) yielded 4% higher total tuber yield over Kufri Lalit (33.21 t/ha) at 75 days with nearly 90% marketable tuber yield. At 90 days, advanced clone MSP/16-307 (49.01 t/ha) yielded 5, 7 and 3% higher total tuber yield over Kufri Lalima (46.81 t/ha), Kufri Lalit (45.63 t/ha) and Kufri Neelkanth (47.46 t/ha). It produced nearly 94% marketable tuber yield as compared to Kufri Lalima (93%), Kufri Lalit (95%) and Kufri Neelkanth (90%). It is pertinent to mention that existing control varieties were used due to non-availability of matching control for purple flesh colour available in the advanced clone MSP/16-307.

## Multi-location testing

Replicated multi-location yield trials along with controls were conducted under AICRP on Potato during 2021-22 and 2022-23 at 15 locations (Table 2 and 3) in North Indian plains comprising northern, central and eastern plains at 75 and 90 days crop duration.

## Crop duration (75 days)

***Northern plains:*** Based on performance at Hisar, Jalandhar, Modipuram and Pantnagar, the advanced clone MSP/16-307 produced a total tuber yield of 31.49 t/ha and it varied from 23.39 t/ha (Modipuram) to 38.44 t/ha (Pantnagar). The performance of the advanced clone MSP/16-307 (/31.49 t/ha) was at par with the control Kufri Manik (31.79 t /ha). The advanced clone MSP/16-307 produced nearly 89% marketable tuber yield (Table 2).

***Central plains:*** Based on performance at Chindwara, Gwalior, Deesa, Kanpur and Raipur, the advanced clone MSP/16-307 produced 30.15 t/ha total tuber yield and it varied from 17.87 t/ha (Kanpur) to 47.55 t/ha (Gwalior). The performance of MSP/16-307

**Table 2. Performance of MSP/16-307 in AICRP replicated yield trials at 75 days (pooled over 2021-22 and 2022-23)**

| Regions | Locations | Total tuber yield (t/ha) | | | Marketable tuber yield (t/ha) | | |
|---|---|---|---|---|---|---|---|
| | | MSP/16-307 | Kufri Manik | Kufri Neelkanth | MSP/16-307 | Kufri Manik | Kufri Neelkanth |
| Northern plains | Hisar | 30.42 | 32.54 | 33.65 | 26.46 | 28.22 | 30.36 |
| | Jalandhar | 33.31 | 33.09 | 37.24 | 31.18 | 30.62 | 33.66 |
| | Modipuram | 23.39 | 25.97 | 29.53 | 18.48 | 22.32 | 25.23 |
| | Pantnagar | 38.84 | 35.54 | 33.86 | 36.24 | 33.24 | 30.23 |
| | Mean | 31.49 | 31.79 | 33.57 | 28.09 | 28.60 | 29.87 |
| Central plains | Chhindwara | 24.03 | 26.20 | 31.37 | 21.08 | 23.02 | 27.49 |
| | Gwalior* | 47.55 | - | 47.10 | 42.64 | - | 42.12 |
| | Deesa | 35.91 | 30.46 | 35.41 | 33.04 | 29.57 | 32.54 |
| | Kanpur | 17.87 | 18.66 | 33.96 | 15.31 | 14.93 | 29.50 |
| | Raipur | 25.39 | 24.16 | 38.38 | 23.03 | 22.44 | 35.86 |
| | Mean | 30.15 | 24.87 | 37.24 | 27.02 | 22.49 | 33.50 |
| Eastern plains | Bhubaneshwar | 21.97 | 16.05 | 22.80 | 19.16 | 14.67 | 20.75 |
| | Faizabad | 26.48 | 30.58 | 27.93 | 24.03 | 27.62 | 25.08 |
| | Jorhat | 15.66 | 16.47 | 17.17 | 10.56 | 11.03 | 11.89 |
| | Kalyani | 30.83 | 28.82 | 29.71 | 28.79 | 26.69 | 28.00 |
| | Patna | 22.71 | 28.67 | 24.64 | 20.57 | 26.85 | 21.76 |
| | Mean | 23.53 | 24.12 | 24.45 | 20.62 | 21.37 | 21.50 |
| Overall mean | | 28.17 | 26.71 | 31.62 | 25.04 | 23.94 | 28.18 |
| *2021-22 | CD (0.05) | Genotype: 0.65 | Year × Location × Genotype: 3.30 | | Genotype: 0.59 | Year × Location × Genotype: 3.02 | |

**Table 3. Performance of MSP/16-307 in AICRP replicated yield trials at 90 days (pooled over 2021-22 and 2022-23)**

| Regions | Locations | Total tuber yield (t/ha) | | | Marketable tuber yield (t/ha) | | |
|---|---|---|---|---|---|---|---|
| | | MSP/16-307 | Kufri Manik | Kufri Neelkanth | MSP/16-307 | Kufri Manik | Kufri Neelkanth |
| Northern plains | Hisar | 34.33 | 37.23 | 37.33 | 31.03 | 33.75 | 33.98 |
| | Jalandhar | 43.10 | 40.95 | 45.87 | 40.71 | 38.08 | 41.47 |
| | Modipuram | 27.89 | 29.55 | 32.93 | 24.96 | 27.31 | 29.52 |
| | Pantnagar | 41.75 | 39.82 | 37.25 | 38.68 | 38.04 | 33.41 |
| | Mean | 36.77 | 36.89 | 38.35 | 33.84 | 34.30 | 34.60 |
| Central plains | Chhindwara | 27.04 | 28.86 | 35.05 | 23.71 | 26.04 | 30.73 |
| | Gwalior* | 53.48 | - | 56.23 | 50.45 | - | 53.35 |
| | Deesa | 41.05 | 40.44 | 44.19 | 39.39 | 39.14 | 42.11 |
| | Kanpur | 21.22 | 24.55 | 39.41 | 18.82 | 18.93 | 35.02 |
| | Kota | 30.77 | 32.90 | 42.54 | 29.75 | 31.96 | 40.88 |
| | Raipur | 29.21 | 31.31 | 42.57 | 26.37 | 27.60 | 39.58 |
| | Mean | 33.79 | 31.61 | 43.33 | 31.41 | 28.73 | 40.28 |
| Eastern plains | Bhubaneshwar | 20.22 | 17.77 | 22.48 | 18.13 | 16.43 | 20.76 |
| | Faizabad | 27.76 | 32.93 | 29.55 | 24.81 | 31.75 | 28.06 |
| | Jorhat | 19.70 | 20.15 | 21.06 | 14.39 | 15.36 | 15.74 |
| | Kalyani | 32.88 | 32.08 | 31.88 | 31.27 | 30.08 | 30.20 |
| | Patna | 28.99 | 32.68 | 30.84 | 25.38 | 30.24 | 27.36 |
| | Mean | 25.91 | 27.12 | 27.16 | 22.80 | 24.77 | 24.42 |
| Overall mean | | 31.96 | 31.52 | 36.61 | 29.19 | 28.91 | 33.48 |
| *2021-22 | CD (0.05) | Genotype: 0.63 | Year × Location × Genotype: 3.33 | | Genotype: 0.63 | Year × Location × Genotype: 3.31 | |

(30.15 t /ha) was superior to the control Kufri Manik (24.87 t/ha) by 21%. The advanced clone MSP/16-307 produced nearly 90% marketable tuber yield.

***Eastern plains*:** Based on performance at Bhubaneswar, Faizabad, Jorhat, Kalyani and Patna, the advanced clone MSP/16-307 produced 23.53 t/ha total tuber yield and it varied from 15.66 t/ha (Jorhat) to 30.83 t/ha (Kalyani). The advanced clones with a total tuber yield of 23.53 t/ha remained at par with Kufri Manik (24.12 t/ha) and Kufri Neelkanth (24.45 t/ha). The advanced clone MSP/16-307 produced nearly 88% marketable tuber yield.

Overall, MSP/16-307 (28.17 t/ha) recorded 5% higher tuber yield than control Kufri Manik (26.71t/ha). However, the marketable yield of 89% recorded in the advanced clone was statistically at par with both the controls viz. Kufri Manik and Kufri Neelkanth (89%).

## Crop duration (90 days)

***Northern plains:*** Based on performance at Hisar, Jalandhar, Modipuram and Pantnagar, the advanced clone MSP/16-307 produced a total tuber yield of 36.77 t/ha and it varied from 27.89 t/ha (Modipuram) to 43.10 t/ha (Jalandhar). The advanced clone with a total tuber yield of 36.77 t/ha remained at par with Kufri Manik (36.89 t/ha) and Kufri Neelkanth (38.35 t/ha). The advanced clone MSP/16-307 produced nearly 92% marketable tuber yield (Table 3).

***Central plains:*** Based on performance at Chindwara, Gwalior, Deesa, Kanpur, Kota and Raipur, the advanced clone MSP/16-307

produced 33.79 t/ha total tuber yield and it varied from 21.22 t/ha (Kanpur) to 53.48 t/ha (Gwalior). The performance of MSP/16-307 (33.79 t /ha) is superior to the control Kufri Manik (31.61 t/ha) by 7%. The advanced clone MSP/16-307 produced nearly 93% marketable tuber yield.

***Eastern plains*:** Based on performance at Bhubaneswar, Faizabad, Jorhat, Kalyani and Patna, the advanced clone MSP/16-307 produced 25.91 t/ha total tuber yield and it varied from 19.70 t/ha (Jorhat) to 32.88 t/ha (Kalyani). The advanced clones with a total tuber yield of 25.91 t/ha remained at par with Kufri Manik (27.12 t/ha) and Kufri Neelkanth (27.16 t/ha). The advanced clone MSP/16-307 produced nearly 88% marketable tuber yield.

On an overall basis, advanced clone MSP/16-307 produced a total tuber yield of 31.96 t/ha and remained at par with Kufri Manik (31.52 t/ha) with nearly 91% marketable tuber yield at 90 days crop duration.

**Tuber dry matter content:** In station trials conducted during 2019-20 and 2020-21 (Table 4), the advanced clone had comparable mean tuber dry matter content (%) of 15 and 17 at 75 and 90 days of crop respectively in comparison to the control Kufri Lalima (16 and 21%), Kufri Lalit (16 and 18%) and Kufri Neelkanth (17 and 20%). However, in multi-location AICRP potato trials during 2021-22 & 2022-23 (Table 5), the advanced clone possessed statistically at par tuber dry matter to the tune of 17% and 19% in 75 and 90 days crop respectively over the control Kufri Manik (17 and 18%) and Kufri Neelkanth (17 and 19%).

**Keeping quality:** The advanced clone has a medium tuber dormancy period (6-8 weeks) and possesses very good keeping quality under country store conditions. Storage study at station trials (Table 6) revealed that advanced clone is a very good keeper due to less rottage (0.27%), and low total weight loss of 6.75% as compared to controls Kufri Lalima (0.72 and 6.37); Kufri Lalit (2.14 and 8.28%); Kufri Neelkanth (0.11 and 7.97) and Kufri Manik (2.44 and 14.60%). In AICRP (Potato) multi-location trials (Table 7), the advanced clone MSP/16-307 had a lower total weight loss of 19% as compared to control Kufri Neelkanth (21%).

**Nutritional content:** The nutritional properties of advanced clone MSP/16-307 render it more superior to the other control varieties. In station trials, the advanced clone exhibited maximum anthocyanin content to the tune of 42.05 and 80.66 mg/100g FW in its flesh and skin, respectively, in comparison to the controls. Also, ascorbic acid and flavouring compounds (42.75 mg/100g FW and 4.68 ug/g) present in flesh were highest in the MSP/16-307 than in control varieties (Table 8).

In AICRP multi-location replicated trials conducted at five locations namely Pune, Hisar, Kanpur, Raipur and Deesa, the advanced clone MS/16-307 (51.52 mg/100g

**Table 4. Tuber dry matter content (%) of MSP/16-307 at Modipuram, Meerut**

| Genotypes | Tuber dry matter (%) | | | | | |
|---|---|---|---|---|---|---|
| | 2019-20 | | 2020-21 | | Mean | |
| | 75 days | 90 days | 75 days | 90 days | 75 days | 90 days |
| MSP/16-307 | 14.02 | 16.24 | 16 | 18.27 | 15.01 | 17.26 |
| Kufri Lalima | 15.74 | 20.61 | 17.13 | 20.39 | 16.44 | 20.50 |
| Kufri Lalit | 14.40 | 16.63 | 17.31 | 19.46 | 15.86 | 18.05 |
| Kufri Neelkanth | 17.87 | 18.85 | 17.11 | 20.24 | 17.49 | 19.54 |
| CD (0.05) | 1.43 | 0.64 | 0.60 | 1.06 | 1.02 | 0.85 |

**Table 5. Tuber dry matter content (%) of MSP/16-307 in AICRP trials (pooled over 2021-22 & 2022-23)**

| Regions | Locations | 75 days | | | 90 days | | |
|---|---|---|---|---|---|---|---|
| | | MSP/16-307 | Kufri Manik | Kufri Neelkanth | MSP/16-307 | Kufri Manik | Kufri Neelkanth |
| Northern plains | Hisar | 16.54 | 16.80 | 15.80 | 17.68 | 17.97 | 16.56 |
| | Jalandhar | 15.59 | 15.11 | 14.53 | 15.88 | 15.58 | 15.06 |
| | Modipuram | 14.28 | 14.87 | 16.28 | 14.73 | 15.57 | 17.17 |
| | Mean | 15.47 | 15.59 | 15.54 | 16.10 | 16.37 | 16.26 |
| Central plains | Chhindwara | 18.70 | 18.28 | 17.84 | 19.25 | 18.79 | 18.61 |
| | Gwalior* | 16.49 | - | 17.80 | 18.18 | - | 18.75 |
| | Deesa | 18.30 | 17.81 | 18.99 | 20.54 | 18.66 | 19.63 |
| | Kanpur | 16.19 | 15.13 | 14.61 | 17.86 | 16.19 | 15.55 |
| | Raipur | 20.16 | 18.51 | 18.45 | 21.39 | 19.27 | 19.27 |
| | Kota | - | - | - | 19.69 | 18.99 | 20.66 |
| | Mean | 17.97 | 17.43 | 17.54 | 19.49 | 18.38 | 18.75 |
| Eastern plains | Bhubaneshwar | 16.57 | 18.51 | 16.49 | 17.74 | 19.30 | 18.71 |
| | Faizabad | 17.51 | 17.52 | 17.41 | 18.10 | 18.10 | 17.61 |
| | Jorhat | 22.86 | 22.66 | 22.69 | 22.68 | 22.75 | 22.78 |
| | Kalyani | 18.64 | 17.01 | 19.43 | 20.23 | 18.22 | 20.54 |
| | Patna | 15.08 | 13.67 | 16.50 | 16.42 | 15.17 | 18.58 |
| | Mean | 18.13 | 17.87 | 18.51 | 19.03 | 18.71 | 19.64 |
| Overall | Mean | 17.46 | 17.16 | 17.45 | 18.60 | 18.04 | 18.53 |
| *2021-22 | CD (0.05) | Genotype: 0.14 | Year × Location × Genotype: 0.69 | | Genotype: 0.13 | Year × Location × Genotype: 0.67 | |

**Table 6. Keeping quality of MSP/16-307 at Modipuram, Meerut (2019-20 and 2020-21)**

| Genotypes | Dormancy (<or>) than 6 weeks | Sprouting (%) | | Weight loss (%) after 75 days of storage | | | |
|---|---|---|---|---|---|---|---|
| | | At 6 weeks | At 75 days | Rottage | Sprouting | Physiological | Total |
| MSP/16-307 | 6-8 weeks | 2.87 | 100.00 | 0.27 | 0.58 | 5.91 | 6.75 |
| Kufri Lalima | >10 weeks | 0.51 | 45.34 | 0.72 | 0.17 | 5.48 | 6.37 |
| Kufri Lalit | >10 weeks | 13.19 | 73.39 | 2.14 | 0.20 | 5.94 | 8.28 |
| Kufri Neelkanth | 6-8 weeks | 9.48 | 98.31 | 0.11 | 0.64 | 7.22 | 7.97 |
| Kufri Manik* | <6 weeks | 85.39 | 97.00 | 2.44 | 0.95 | 11.10 | 14.60 |

**Table 7. Keeping quality (Total weight loss) of MSP/16-307 at AICRP Locations (90 days) over 2021-22* and 2022-23****

| Locations | MSP/16-307 | Kufri Manik | Kufri Neelkanth |
|---|---|---|---|
| Bhubaneshwar* | 29.41 | 5.82 | 10.80 |
| Deesa | 6.33 | 18.13 | 38.15 |
| Faizabad | 14.50 | 14.85 | 15.65 |
| Hisar** | 19.50 | 15.00 | 21.50 |
| Kanpur | 31.60 | 17.70 | 27.70 |
| Modipuram | 12.00 | 15.75 | 14.20 |
| Mean | 18.89 | 14.54 | 21.33 |

**Table 8. Nutritional components in MSP/16-307 at Modipuram, Meerut**

| Genotypes | Antho-cyanins (mg/100g FW) | | Carote-noids (ug/100 g FW) | Ascorbic acid (mg /100 g FW) | Flavouring compounds (AMP+GMP) ug/g |
|---|---|---|---|---|---|
| | Flesh | Skin | Flesh | Flesh | Flesh |
| MSP/16-307 | 42.05 | 80.66 | 161.00 | 42.75 | 4.68 |
| Kufri Lalima | 3.59 | 8.53 | 245.25 | 34.00 | 2.62 |
| Kufri Lalit | 4.36 | 7.83 | 296.00 | 18.00 | 3.40 |
| Kufri Neelkanth | 2.95 | 18.97 | 669.50 | 27.75 | 2.52 |

*Anthocyanins, Carotenoids, Ascorbic acid (means of four years: 2017-18, 2018-19, 2019-20, 2020-21); **Flavouring compounds (AMP+GMP) (means of two years: 2018-19, 2019-20)

fresh weight) exceeded the controls Kufri Manik (37.99) and Kufri Neelkanth (29.04) for ascorbic acid by 35% and 77% respectively. The advanced clone (32.36 mg/100g fresh weight) possessed higher anthocyanin content by 21% over Kufri Manik (26.66). Likewise, carotenoid contents were 64% and 51% higher in MSP/16-307 (163.04 ug/100g fresh weight) as compared to control varieties Kufri Manik (99.20) and Kufri Neelkanth (107.52), respectively (Table 9).

**Micronutrients:** The micronutrient studies at multi location trials revealed that the advanced clone MS/16-307 (zinc-22.77 ppm and iron-32.23 ppm) was superior to Kufri Manik (17.60 ppm) for zinc content by 29% and Kufri Neelkanth (iron-32.02 ppm) by 1% for iron content in flesh (Table 10)

## Usage

The advanced clone MSP/16-307 released as variety Kufri Jamunia possessing attractive, dark purple, oblong tubers with shallow eyes and purple flesh, adds novelty to various dishes. The tubers are rich in anthocyanins, and micronutrients, especially zinc and iron, prove to be beneficial in enriching health.

**Table 9. Nutritional components in MSP/16-307 at AICRP centers (2022-23)**

| Ascorbic acid (mg/100g fresh weight) in flesh | | | | | | |
|---|---|---|---|---|---|---|
| Genotypes | Pune | Hisar | Kanpur | Raipur | Deesa | Mean |
| MSP/16-307 | 50.00 | 53.80 | 58.50 | 48.30 | 47.02 | 51.52 |
| Kufri Manik | - | 46.90 | 38.90 | - | 28.16 | 37.99 |
| K Neelkanth | 27.40 | 36.30 | 31.60 | 25.00 | 24.90 | 29.04 |
| Anthocyanins (mg/100g fresh weight) in flesh | | | | | | |
| Genotypes | Pune | Hisar | Kanpur | Raipur | Deesa | |
| MSP/16-307 | 15.95 | 69.34 | 23.16 | 7.16 | 46.21 | 32.36 |
| Kufri Manik | - | 69.53 | 0.79 | - | 9.65 | 26.66 |
| K Neelkanth | 0.43 | 1.08 | 1.96 | 0.89 | 1.26 | 1.12 |
| Carotenoids (ug/100g fresh weight) in flesh | | | | | | |
| Genotypes | Pune | Hisar | Kanpur | Raipur | Deesa | |
| MSP/16-307 | 185.60 | 130.80 | 15.60 | 298.40 | 184.80 | 163.04 |
| Kufri Manik | - | 84.00 | 108.00 | - | 105.60 | 99.20 |
| K Neelkanth | 37.60 | 80.40 | 94.80 | 235.20 | 89.60 | 107.52 |

**Table 10. Micro-nutrients MSP/16-307 at AICRP Centers (2022-23)**

| Zn (ppm) flesh | | | | | | |
|---|---|---|---|---|---|---|
| Genotypes | Pune | Hisar | Kanpur | Raipur | Deesa | Mean |
| MSP/16-307 | 29.76 | 20.85 | 15.61 | 27.17 | 20.44 | 22.77 |
| Kufri Manik | - | 17.98 | 17.73 | - | 17.10 | 17.60 |
| K Neelkanth | 33.42 | 21.55 | 17.25 | 23.28 | 24.17 | 23.93 |
| Fe (ppm) flesh | | | | | | |
| Genotypes | Pune | Hisar | Kanpur | Raipur | Deesa | Mean |
| MSP/16-307 | 35.41 | 34.50 | 29.11 | 30.65 | 31.48 | 32.23 |
| Kufri Manik | - | 33.53 | 33.67 | - | 33.58 | 33.59 |
| K Neelkanth | 34.00 | 33.78 | 28.34 | 33.85 | 30.12 | 32.02 |

This clone reported the least peeling losses due to oblong shape and shallow eyes, easy to cook (15-20 minutes) and possesses a pleasant aroma and mealy texture. Moreover, tubers do not show any deformities like cracking or hollow heart. It is table purpose variety and can serve the value to the meal of the consumers for cololurful vegetable curry, parontha, puri, raita etc. The milling of dehydrated form of Kufri Jamunia tubers produces anthocyanin rich daliya, suji and flour. These milled dehydrated products can be successfully used for the preparation of sweet porridge (Daliya), halva, upma, part of dosa batter, and idli (Suji) and roti, paratha, soup, cookies, other bakery items and many more products (potato flour).

The results on organoleptic performance of Kufri Jamunia (sample size of 64 persons, including 11 women) indicated that 91% persons graded Kufri Jamunia between good to excellent for tuber appearance and 90% persons found its flavour between moderate to extreme. Based on texture (mouth feel), 77% persons indicated Kufri Jamunia to have a mealy texture to floury. About 56% people found Kufri Jamunia to have a very good taste, while 41% persons recorded of neutral taste. The overall acceptability analysis indicated that 95% person graded Kufri Jamunia from good to excellent. Owing to its nutritional properties, desirable traits, good keeping quality, and organoleptic taste, the clone will favour its acceptance.

## Disease Resistance

Advance clone MSP/16-307 (AUDPC: 910.63; lesion area: 4.39 $cm^2$) showed late blight reactions as compared to Kufri Bahar (AUDPC: 1073.4; lesion area: 7.52 $cm^2$), Kufri Neelkanth (AUDPC: 956.84; lesion area: 5.38 $cm^2$) and Kufri Manik (AUDPC: 1039.51; lesion area: 4.98 $cm^2$) when investigated under field conditions and through standard detached leaf method, respectively (Table11).

**Table 11. Late blight screening of MSP/16-307 at Modipuram, Meerut**

| Genotypes | Year | Field screening | | Detached leaf | |
|---|---|---|---|---|---|
| | | AUDPC | rAUDPC | Lesion area ($cm^2$)* | Grading |
| MSP/16-307 | 2019-20 | 748.08 | 0.416 | 4.14 | MR |
| | 2020-21 | 1073.17 | 0.511 | 4.64 | MR |
| | Mean | 910.63 | 0.46 | 4.39 | MR |
| Kufri Bahar | 2019-20 | 871.83 | 0.484 | 6.27 | S |
| | 2020-21 | 1275 | 0.607 | 8.77 | S |
| | Mean | 1073.4 | 0.55 | 7.52 | S |
| Kufri Neelkanth | 2019-20 | 815.17 | 0.453 | 5.12 | S |
| | 2020-21 | 1098.5 | 0.523 | 5.63 | S |
| | Mean | 956.84 | 0.49 | 5.38 | S |
| Kufri Manik | 2022-23 | 1039.51 | 0.55 | 4.98 | MR |

***Grading:** Lesion area ($cm^2$): Up to 1.0- Highly resistant (HR); 1.1 to 2.5- Resistant (R); 2.51-5.0- Moderately resistant (MR), > 5.0 –Susceptible(S)*

It is moderately resistant to late blight under laboratory conditions; however, it was found susceptible in field conditions.

## Production technology

***Crop management:*** The optimum tuber yield of 32-35 t/ha was attained by the advanced clone MSP/16-307 following the recommended package of practices and worked out nutrition doses. Field preparation by ploughing, harrowing, and planking is preferred for better soil status. Planting time in the North Indian plains remains optimum from the second fortnight of October to the first fortnight of November. Tubers for planting must be healthy and free from pests, diseases and any disorders. Potato planting at 20 cm in 60 cm rows for seed size tubers of diameter 30-55mm (40-60g) provides optimum tuber yield and seed rate shall be approximately 35-40 q/ha. Seed tubers from the cold store are to be taken out at least 10 days before planting. Avoid seed bags in direct sunlight as it may result in rottage due to sudden exposure to high temperatures. Spread

the tubers in thin layer under shade in diffused light for sprouting and allow sprouts to become 0.5-1.0 cm long, thick and green. Carry sprouted tubers to the fields in seed trays or baskets for planting to avoid sprout damage. Remove white, pale, thin sprouted, diseased and rotten tubers. A planting depth of 10-12 cm is better for achieving uniform emergence. Nitrogen, phosphorous and potassium levels were 180, 80 and 100 kg/ha, respectively, in trial site at Modipuram. Green manuring before the potato crop is beneficial for crop in several ways, including crop nutrition. At planting 10-15 t/ha well rotten FYM may also be applied to provide the seed bed a better tilth and nutrition to the potato crop. These crop management practices shall reduce approximately one third dose of nitrogen, and half doses of phosphorus and potassium. Thus, half the adjusted dose of nitrogen and full adjusted doses of $P_2O_5$ and $K_2O$ should be applied at planting. The remaining half adjusted dose of nitrogen should be applied 20-25 days after planting i.e. at the time of inter-cultivation and earthing. Response to nutrient doses in different agro-ecologies may differ and regional recommendations may be adopted for obtaining optimum productivity. Pre-sowing irrigation is done to ensure uniform emergence. If this is not given then the first irrigation should be done 4-6 days after planting. Post planting irrigations are kept light and applied subsequently at 7-10 days intervals in sandy loam soil and 10-12 days in heavy soil. Potato ridges must not be submerged under water in any case and arrangements for drainage should also be developed, keeping unseasonal rains during crop season (Rawal *et al.*, 2021).

### *Plant protection measures*

For the management of soil and tuber borne diseases, tubers are treated with boric acid 3% before storage. Planting done after seed tuber (chitted) treated with pencycuron 22.9% SC @ 0.25% (25g/10 l of water) for 10 minutes can take care of black scurf. The clone is susceptible to late blight under field conditions, therefore, prophylactic spray with mancozeb 75% WP or propineb 70% WP or chlorothalonil @ 0.25% (2.5 g/l of water) as soon as the weather conditions become congenial for late blight or about a week in advance of canopy closure, whichever is earlier. On appearance of the disease in the field, apply any of the systemic/ translaminar fungicides viz., cymoxanil + mancozeb or fenamidone + mancozeb @ 0.3% (3 g/l of water) or dimethomorph (0.1%) or ametoctradin + dimethmorph (0.2%) or azoxystrobin + tebuconozol (0.1%) fungicides. Apply contact fungicides viz., mancozeb or propineb or chlorothalonil (0.25%) after 8-10 days of 2nd spray of systemic fungicides. However, if the weather is highly congenial, repeat application of systemic/translaminar fungicide may be done.

For the management of whiteflies, aphids and thrips in seed crops acting as vectors, dipping sprouted tubers with imidacloprid 200 SL (17.8 w/w) @ 0.04% (4 ml/10 l of water) for 10 minutes can be effective. On 80% crop emergence, first spray of pymetrozine 50WG @ 0.06% (6g/10 l of water) followed by second spray of thiamethoxam (25 WG) @ 0.05% (5g/10 l of water), third spray of flonicamid 50WG @0.04% (4g/10 l of water), fourth of thiamethoxam (25 WG) @ 0.05% (5g/10 l of water), and last spray of flonicamid 50WG @0.04% (4g/10 l of water) or imidacloprid 200 SL (17.8 w/w) @ 0.03% (3 ml/10 l of water) or thiamethoxam (25 WG) @ 0.05% (5g/10 l of water) each done after 10-15 days after every consecutive spray. Placing yellow sticky traps (15x30 $cm^2$ size) just above the canopy height @ 60 traps/ ha at equidistance from each other for mass trapping of white flies/aphids.

***Harvesting***: Withhold irrigation 10-12 days prior to harvesting. Crop harvested after 15-20 days of haulm cutting and at proper soil moisture. After harvest, produce air dried and tubers kept in heaps covered with 25-30 cm thick crop residue/ paddy straw for 10-15 days in shade for curing of skin. All damaged and rotten tubers are removed, followed by grading the produce, packaging in gunny bags and labelling them. Storage in cold storage immediately after post-harvest operations.

## ADAPTABILITY

Advanced clone MSP/16-307 named and released as variety Kufri Jamunia has performed well in multi-location trials conducted under AICRP on Potato and has been recommended for cultivation in North-Indian plains ((Northern, Central & Eastern plains of India) including the states of Haryana, Punjab, Uttar Pradesh, Uttarakhand (plains), Madhya Pradesh, Rajasthan, Chhattisgarh, Gujarat, Orissa, Assam, West Bengal and Bihar. Kufri Jamunia can serve as a better choice for farmers due to its high anti-oxidants (anthocyanins and carotenoids) & ascorbic acid content and at par iron/zinc content. Owing to its purple colour and good organoleptic taste, it will attract growers, traders and consumers, adding novelty in the preparation of various dishes. Its export potential can also be harnessed in the coming time for destinations like Bangladesh, Bhutan, Nepal, Pakistan and Philippines, where red-skinned tubers are traditionally preferred (Pandey *et al.*, 2000 and Luthra *et al.*, 2004).

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## CONFLICT OF INTEREST

The authors declare that they have no conflict of interest

## ETHICAL STATEMENT

This article does not contain any studies with human participants or animals performed by any of the authors

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