

with high nuclear binding energy. The preponderance of iron (with the highest nuclear binding energy) rich-rocks (seen in the widespread generation ocean floor rocks) since the last 200 Ma is cited as a positive evidence. The transformation inside the Earth continues.

Tassos uses chemistry, physics and mathematics to buttress his point but is candid in his conclusion: 'The approach is qualitative but with quantitative constraints, it is based on current knowledge and on reliable observational and experimental data but, at the same time,

it is not confined by existing theories and interpretations'.

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SCIENTIFIC CORRESPONDENCE

Kufri Chipsona-2: A new high dry matter potato variety for chipping

Most of the potato processing is presently confined to the developed countries^{1,2}, and is still in its infancy in India. The demand for processed products in the country is, however, rising at a fast pace due to increased urbanization, rise in per capita income, increase in number of working women and expanding tourist trade. A large number of processing companies including multinationals have stepped into the field of potato processing. Among processed potato products, chips and French fries are the most popular forms. The potato processing trade needs varieties with above 20% tuber dry matter and low reducing sugars and total phenols, to ensure high recovery of quality processed product³. None of the 31 Indian potato varieties released in the country since 1958 meets these standards. Therefore, there has been a tremendous pressure from the processors to import in bulk from USA and Europe, the tuber material of potato varieties suitable for processing.

To meet the demand for a variety suitable for processing, a crash programme of breeding was launched at the Central Potato Research Institute in 1990. The hybrid MP/91-G was developed following identification of suitable parents⁴. It was evaluated along with Kufri Jyoti (the popular variety used presently in processing) for various characters important in processing at the Central Potato Research Station, Modipuram (29°N 76°E; 222 m above msl) in North western plains and assessed for various parameters important for processing. This hybrid has been christened as Kufri Chipsona-2 and has been notified now by the Central Sub-committee on Crop Standards, Notification and

Release of varieties for Horticultural Crops, Ministry of Agriculture and Co-

operation, Govt of India, New Delhi and recommended as a main crop variety

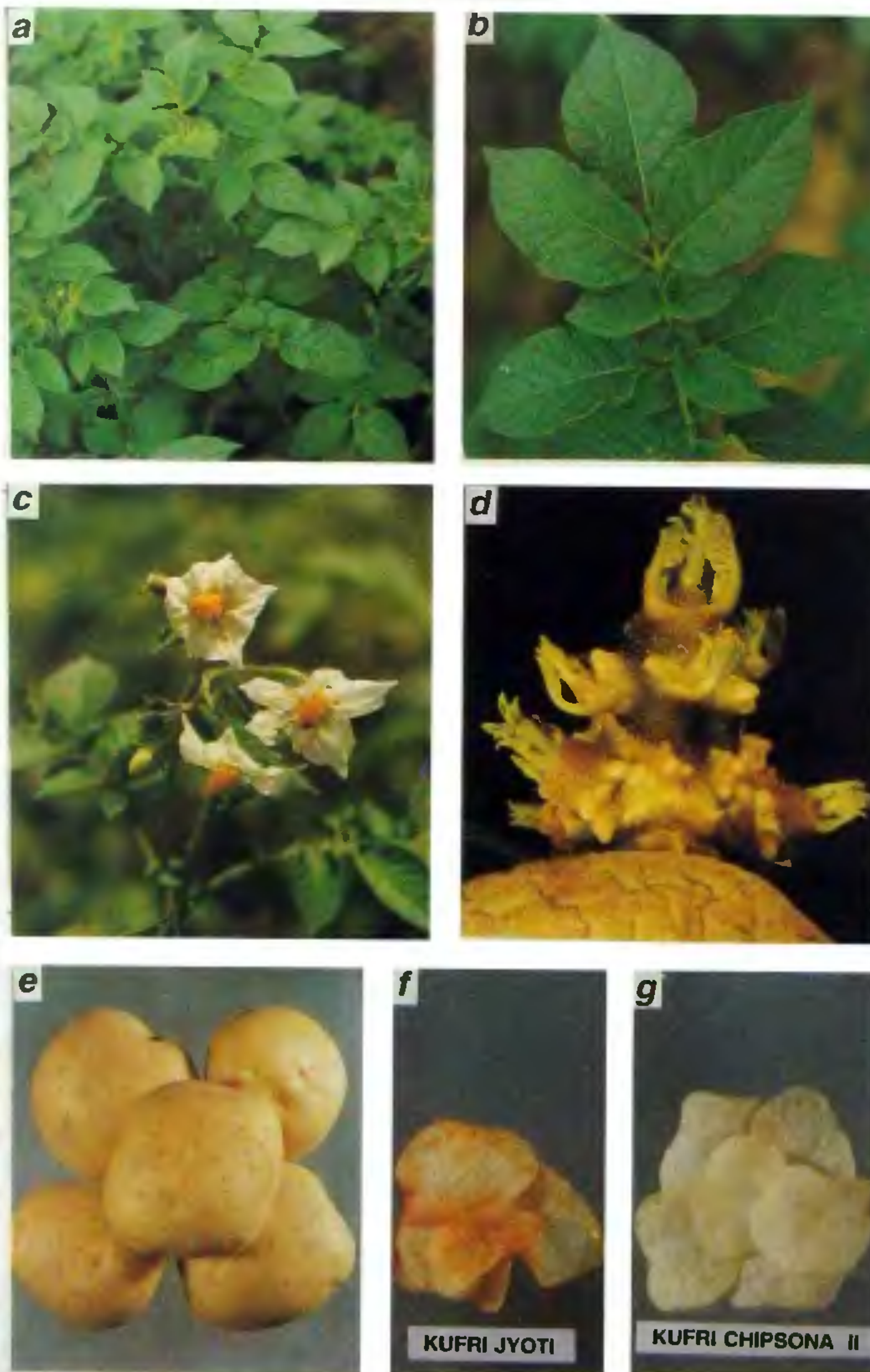


Figure 1. Kufri Chipsona-2. a, plant; b, leaf; c, flowers; d, sprout; e, tubers; f-g, chips.

Table 1. Per cent tuber dry matter, Modipuram

Variety	1993-94 90 days	1994-95 90 days	1995-96		1996-97 100 days	1997-98		Average
			90 days	105 days		100 days	Late planted*	
Kufri Chipsona-2	22.4	22.6	22.0	23.0	22.8	22.6	22.6	22.6
Kufri Jyoti	19.0	20.1	18.0	19.9	18.3	18.2	18.2	18.8

*Crop planted on 10 November and harvested on 25 February.

Table 2. Chip colour at Modipuram

Variety	1994-95 100 d	1995-96			1996-97		1997-98		Average
		90 d	105 d	120 d	100 d	110 d	100 d	Late sown*	
Kufri Chipsona-2	2	1	1	1	3	1	1	1	1.4
Kufri Jyoti	5	6	5	5	5	5	6	6	5.4

Chip colour recorded on scale 1-8, where 1 = white and 8 = dark brown colour; d = crop duration in days.

*Crop planted on 10 November and harvested on 25 February.

Table 3. Industrial processing for chips (Uncle Chipps, Noida, 1997)

Variety	Per cent reducing sugars*	Per cent dry matter**	Per cent brown chips on frying
Kufri Chipsona-2	0.10-0.25	21.2	27.5
Kufri Jyoti	0.25-0.5	17.5	61.3

*Strip test.

**Estimated through specific gravity test.

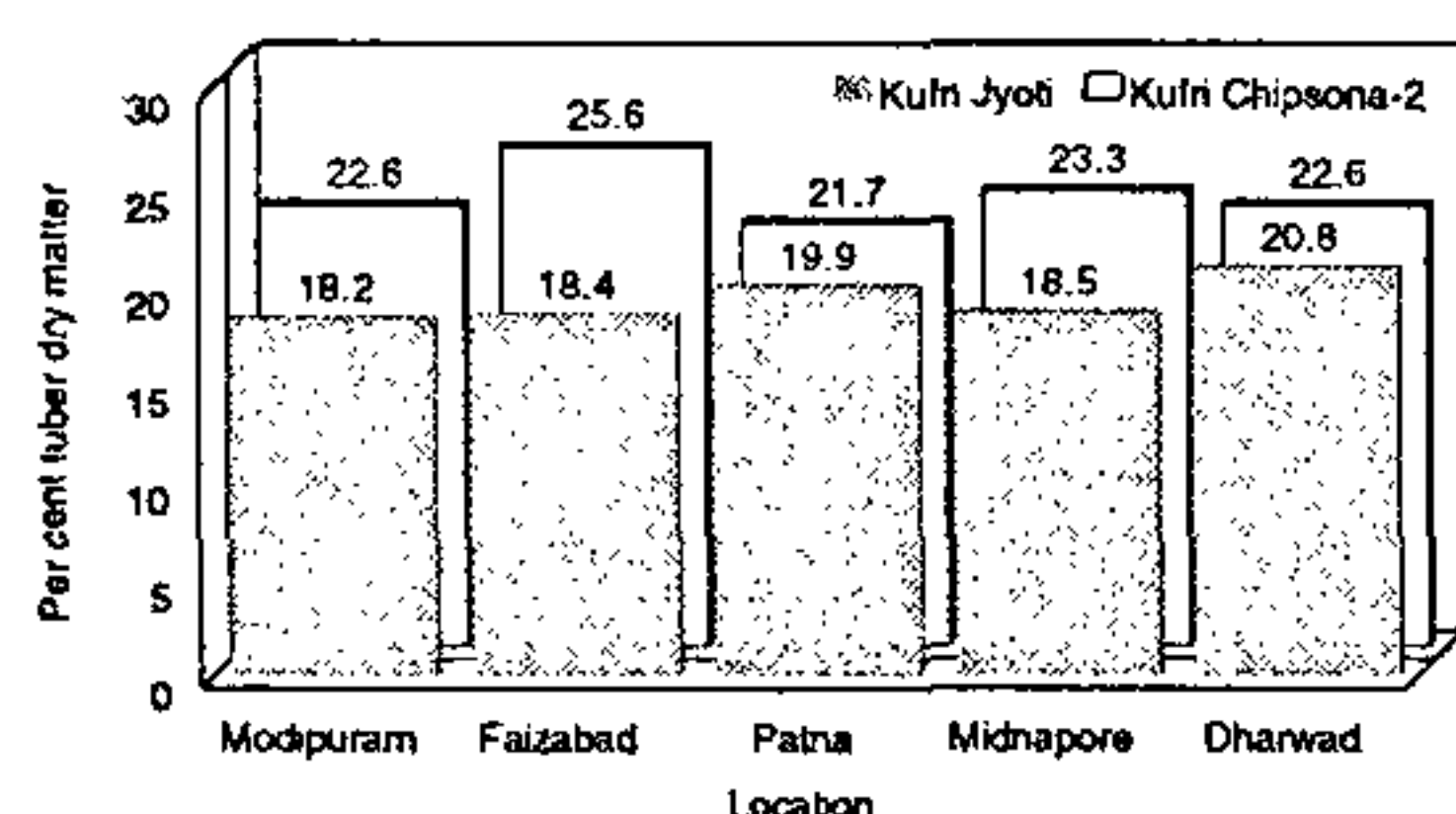


Figure 2. Tuber dry matter of Kufri Chipsona-2 and Kufri Jyoti at various locations.

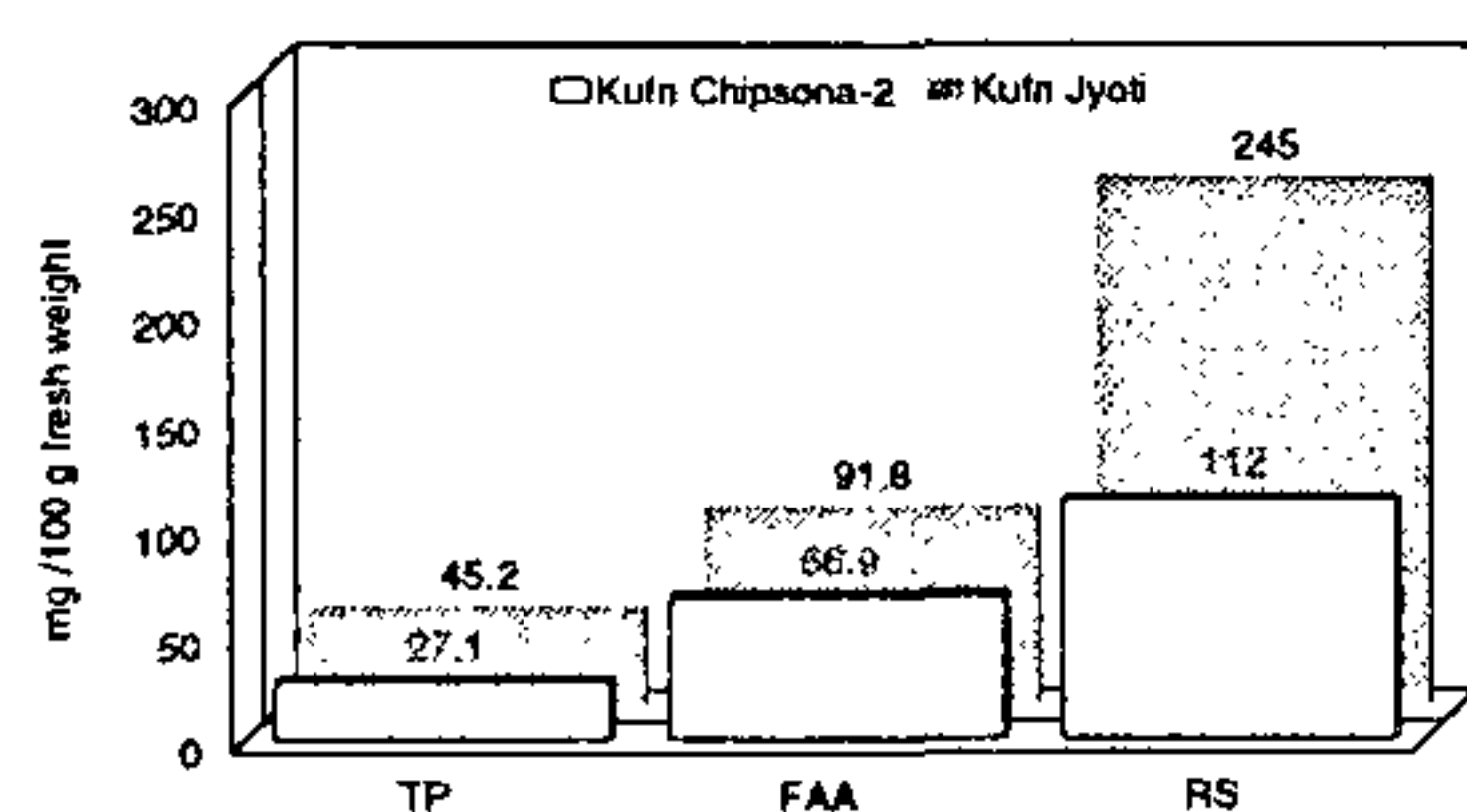


Figure 3. Total phenols (TP), free amino acids (FAA) measured as mg N and reducing sugars (RS) per 100 g fresh tuber weight in Kufri Chipsona-2 and Kufri Jyoti. (Modipuram, 1995-96).

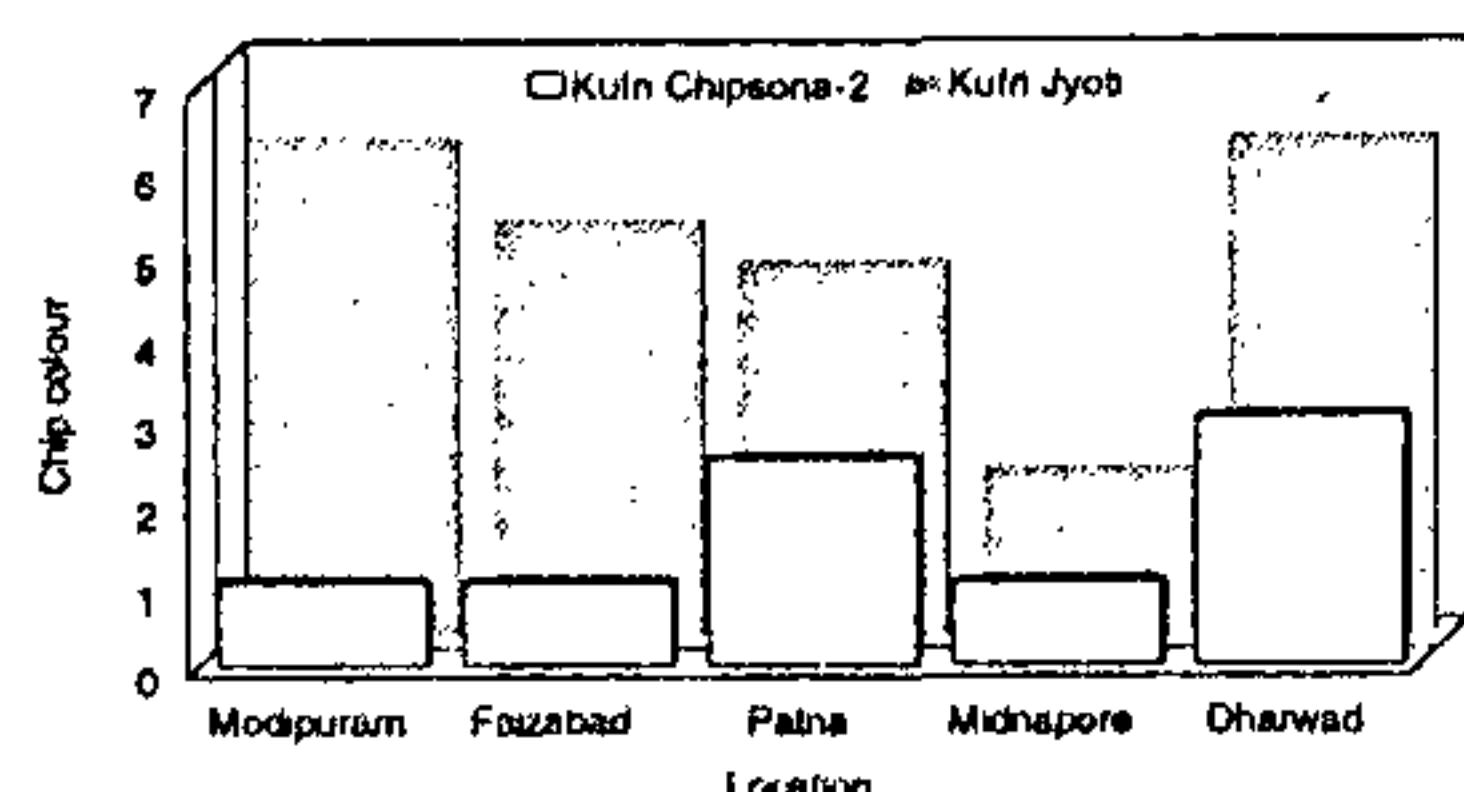


Figure 4. Chip colour of Kufri Chipsona-2 and Kufri Jyoti at various locations (1997-98).

for Indo-Gangetic plains. Kufri Chipsona-2 is a selection from the progeny of the cross of culture F-6 (from Peru) × hybrid QB/B 92-4, an Indian hybrid involving in its parentage the variety Kufri Red and the variety Navajo from USA. This variety is medium tall, erect, vigorous with profusely branched stems. The leaves are open, dark green with small narrow leaflets having slightly wavy margin. The variety bears profuse white flowers and produces tubers of medium size, round to oval shape and cream yellow flesh of waxy texture. The tuber eyes are shallow, the sprouts are green with faint purple colouration (Figure 1).

The tuber dry matter and reducing sugar content of potatoes are the two most important parameters in selecting raw material for processing as these determine the yield, texture and quality of the processed potato products. High levels of reducing sugars result in dark colouration of the fried products⁵. This is due to the reaction of free amino acids with sugars. Besides, phenolic compounds have been associated with enzymatic discolouration which occurs

due to oxidation of these compounds by polyphenol oxidase⁶. In trials conducted at Modipuram during 1993-94 to 1997-98 crop seasons, the tuber dry matter in the variety Kufri Chipsona-2 ranged from 22 to 23% as against 18-20.1% in the control variety Kufri Jyoti (Table 1). At other locations, its tuber dry matter varied from 21.2 to 25.6% as compared to 18.4 to 20.8% in Kufri Jyoti (Figure 2). Thus Kufri Chipsona-2 has consistently given higher tuber dry matter at all the locations. The tuber dry matter is known to influence oil uptake during frying⁷ as with its increase the oil uptake decreases. The use of this variety will thus economize on oil consumption and improve the quality of product which will be less greasy and of low calories. The analysis of tuber material for reducing sugars, total phenols and free amino acids (Figure 3) showed Kufri Chipsona-2 to have lower values of these characters than Kufri Jyoti.

Chip colour is the most important criterion for marketing of the finished product. The chipping industry accepts chip colour in the range of 1 to 3 on a

Table 4. Tuber yield (q/ha) at various locations

Variety	Modipuram							Patna	Dharwad	Faizabad
	93-94	94-95	95-96	96-97	97-98			96-97	1997	97-98
	90 d	90 d	90 d	105 d	100 d	100 d	Late sown*	100 d	100 d	100 d
Kufri Chipsona-2	377	308	293	345	341	205	364	297	93	241
Kufri Jyoti	306	319	325	309	328	201	353	310	67	264

*Crop planted on 10 November and harvested on 25 February; d = crop duration in days.

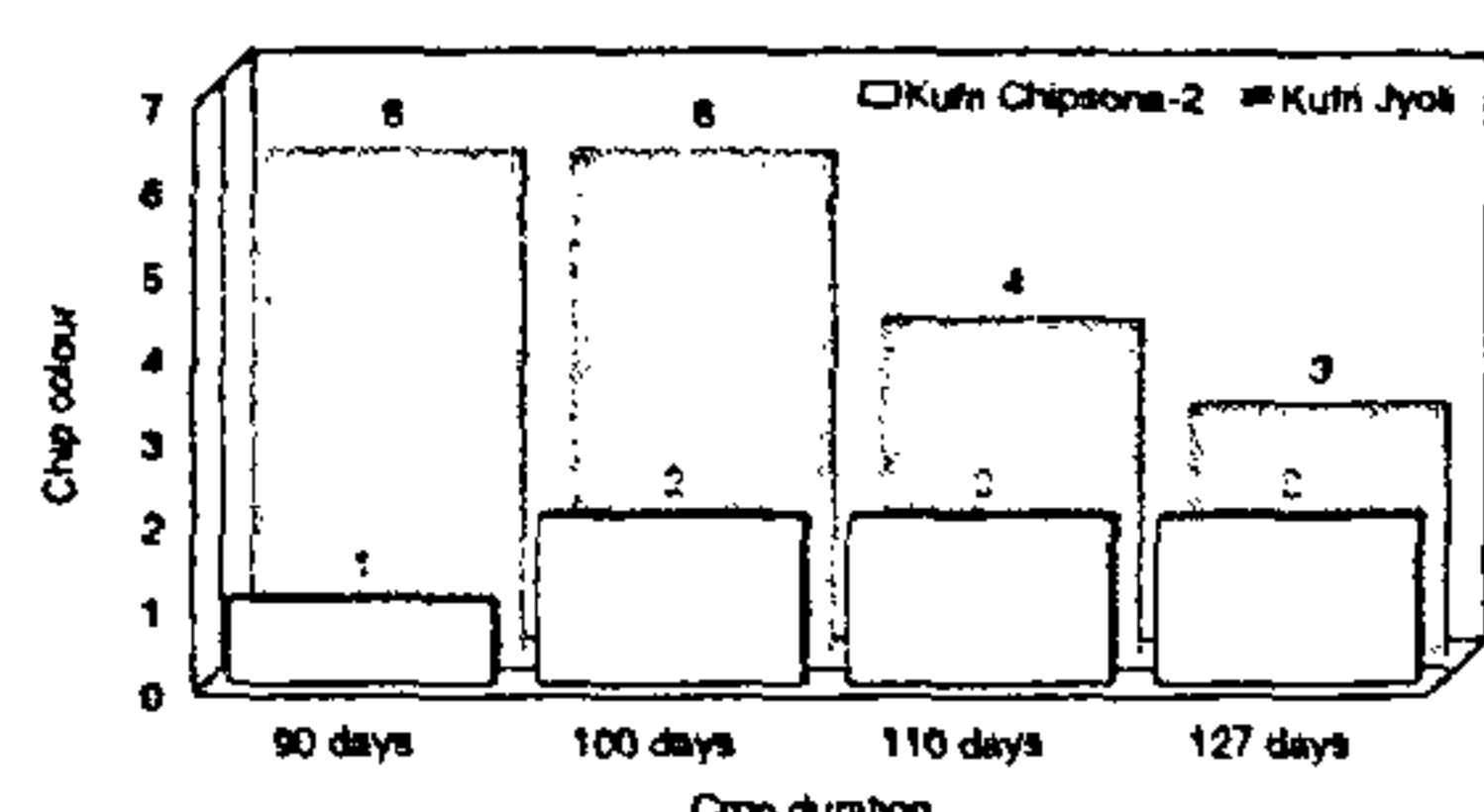


Figure 5. Chip colour of Kufri Chipsona-2 and Kufri Jyoti on different days of harvest (Modipuram, 1997-98).

scale of 1-8 (1 being the lightest and 8 the darkest). The chip colour of Kufri Chipsona-2 at Modipuram during the years 1994-95 to 1997-98 ranged between 1 and 3 (Table 2). It gave light colour chips in the range of 1 to 3 at all the locations, viz. North western, North central and eastern plains, and plateau region. In contrast, the popular processing variety Kufri Jyoti produced chips in the colour range of 4.5 to 6 (Figure 4). The results of trials conducted at Modipuram in 1997-98 crop season have shown that Kufri Chipsona-2 can be harvested at any time starting from 90 days onwards to give acceptable light colour chips (Figure 5). The variety was also test fried for chips under factory conditions at M/s Uncle Chipps, Noida. The results showed a much lower percentage of brown chips in Kufri Chipsona-2 as compared to Kufri Jyoti (Table 3).

In trials conducted at Modipuram during 1993-94 to 1997-98 and at other locations (Table 4) Kufri Chipsona-2 produced about the same yield as Kufri Jyoti. The variety also possesses resistance to late blight⁸ and appears to have potential in *kharif* crop season in

Karnataka. During 1996-97, severe frost occurred during the potato crop season in the North western plains. This variety also showed high tolerance to frost.

The major potato processing industries are located in North western plains of India. However, generally the potatoes grown in cooler North western plains contain relatively less dry matter and more reducing sugars, hence the region is not considered good for procuring potatoes for processing. As we move towards the warmer regions of North eastern plains and peninsular India, the dry matter content in potatoes increases and reducing sugar decreases⁹. The industry presently procures most of the raw material from central plains of Uttar Pradesh and Malwa region of Madhya Pradesh. With the introduction of this variety, it will be possible to produce potatoes of desirable chipping quality even in North western region, thereby saving on the large transportation cost. The development of Kufri Chipsona-2 will eliminate the need to import bulk quantities of potatoes with attendant risk of importing exotic diseases and pests which could wipe out the potato industry in the country. The variety will also help in saving valuable foreign exchange and open up opportunities for our farmers to get better returns on their investment of time and energy. It will also improve the quality of chips available to the consumers and will help in improving export of this value-added potato product.

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