

Potato Variety Differences in Nutrient Deficiency Symptoms and Responses to NPK

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Recent work by researchers in India provides understanding of the subtle yet important differences in varietal expression of nutrient deficiency as well as their variable response to applied nutrients. Crop yield and quality implications for common potato varieties grown in India are discussed.

The knowledge of nutrient deficiency symptoms is a prerequisite for balanced plant nutrition. Experience shows that deficiency symptoms can vary with crop cultivar. Some cultivars exhibit strong symptoms under stress while others may not. Deficiency symptoms often resemble symptoms of disease, which commonly results in misinterpretation and confusion. Therefore, as a guide for nutrient management for potato, field and pot experiments were conducted to document and photograph the differences in nitrogen (N), phosphorus (P), and potassium (K) deficiency symptoms in different cultivars grown in India.

Material and Methods

Field and pot experiments were conducted in 1999 and 2000 at the Central Potato Research Station near Jalandhar, Punjab. The field experiment included three potato cultivars (Kufri Jyoti, Kufri Jawahar, and Kufri Sutlej) with varying rates of N, P and K. Deficiency symptoms were recorded in the field at 50, 70 and 80 days after planting. At harvest, the treatment effect on potato tuber number and yield for different grades...large (>75 g), medium (27 to 75 g) and small (<25 g)...was recorded. The pot experiment was conducted on three cultivars (Kufri Chandramukhi, Kufri Badshah, and Kufri Jyoti) with and without P application in a 1:1 soil/quartz sand mix. The pot experiment was terminated at 45 days, then deficiency symptoms were recorded.

Nutrient Deficiency Symptoms

Nitrogen: At 50 days, N deficiency affected overall plant growth, and bare field ridges were clearly visible in all N-deficient plots. Shoots of deficient plants were upright, thin and bore small, pale green and yellowish leaves. Leaves of Kufri Jyoti and Sutlej cultivars were more

yellowish than Kufri Jawahar. Shoot and leaf numbers were lowest in N-deficient plants, and plant height was about half that of plants that received N, P and K (Table 1). At 80 days, Kufri Jyoti plants died due to induced senescence, but plants of other cultivars were still green.

Phosphorus: At 50 days, P deficiency created abnormal plant growth. However, the spaces between field ridges were not as visible as was observed in N-deficient plots. The shoots were upright and thin, with small, dark green, lusterless leaves. The leaves of Kufri Jyoti showed upward curling, while other cultivars did not exhibit curling. Plant height was reduced, but the degree of stunting was less than N-deficient plots. Further, the reduction in plant height was smallest in Kufri Jawahar and largest in Kufri Sutlej (Table 1). Phosphorus deficiency reduced the number of shoots and leaves in Kufri Jawahar, but not in Kufri Sutlej and Kufri Jyoti. Kufri Jawahar did not exhibit symptoms of leaf curling even up to maturity. However, at 70 days, leaf curling intensified in Kufri Jyoti (Plate 1) and also appeared in Kufri Sutlej (Plate 2).

Potassium: At 50 days, K deficiency reduced plant height to a degree similar to that observed with P deficiency. However, a more severe reduction in plant height was observed in Kufri Sutlej (Table 1). Leaf color was commonly dark green with a bluish tinge. Potassium deficiency reduced the number of shoots and leaves in Kufri Jawahar alone. Leaf area was greatly reduced in Kufri Sutlej and Jyoti. The physical touch of deficient leaves revealed a rough textured surface. At 70 days, leaf color progressed from dark green with bluish tinges to a bronzed color with interveinal chlorosis. Leaf margins also showed scorching (Plates 1, 2 and 3). Lower leaf surfaces showed brown spotting, and the foliage often withered and collapsed prematurely in Kufri Jyoti (Plate 1).

Tuber Yield and Plant Characteristics

Application of N, P and K increased tuber yield

Table 1. Influence of N, P and K fertilizer on height, shoot and leaf number per plant at 60 days after planting in different potato cultivars (mean of eight plants), Jalandhar, Punjab.

Treatment ¹	Potato cultivars			Mean
	K. Sutlej	K. Jawahar	K. Jyoti	
Height per plant , cm				
NPK	75.0	52.4	61.3	62.9
P K	41.0	24.8	28.3	31.4
N K	64.8	48.9	50.6	54.8
N P	63.0	49.8	56.9	56.6
Mean	60.9	44.0	49.3	
Number of shoots per plant				
NPK	3.8	5.3	4.1	4.4
P K	2.9	3.8	3.4	3.4
N K	3.9	4.4	4.1	4.1
N P	4.0	4.6	4.1	4.2
Mean	3.6	4.5	3.9	
Number of leaves per plant				
NPK	388	357	298	348
P K	250	185	154	196
N K	404	372	273	350
N P	422	293	340	352
Mean	366	302	266	
CD (LSD) at 5%	Height	No. of shoots	No. of leaves	
	Cultivar mean	2.8	0.6	34
	Treatment mean	3.4	0.6	39
	Cultivar x Treatment	5.7	1.1	67

¹Rates of fertilizers were 240 kg N, 150 kg P₂O₅, and 180 kg K₂O/ha.

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Plate 1. Nutrient deficiency at 70 days of plant growth of Kufri Jyoti potato.



Table 2. Influence of N, P and K on yield and number of potato tubers in different cultivars, Jalandhar, Punjab.

Treatment ¹	Tuber yield, t/ha				Tuber number, thousand/ha			
	Large ² (>75g)	Medium ² (25-75g)	Small ² (<25g)	Total ³	Large ² (>75g)	Medium ² (25-75g)	Small ² (<25g)	Total ³
K. Sutlej								
NPK	30.6 (71)	11.3 (26)	1.3 (3)	43.2	174 (40)	160 (36)	104 (24)	438
P K	7.8 (40)	11.2 (58)	0.3 (2)	19.3 (45)	59 (19)	204 (65)	52 (16)	315 (72)
N K	26.6 (76)	7.2 (21)	1.1 (3)	34.9 (81)	161 (38)	157 (36)	111 (26)	429 (98)
N P	16.3 (54)	12.9 (43)	0.8 (3)	30.0 (69)	111 (26)	240 (55)	83 (19)	434 (99)
K. Jawahar								
NPK	21.3 (55)	11.9 (30)	5.7 (15)	38.9	80 (24)	219 (29)	344 (46)	743
P K	2.3 (14)	9.8 (59)	4.4 (27)	16.5 (42)	24 (4)	213 (38)	320 (57)	557 (75)
N K	6.7 (24)	17.0 (61)	4.1 (15)	27.8 (71)	44 (7)	303 (46)	306 (47)	653 (88)
N P	6.6 (19)	24.9 (72)	2.9 (8)	34.4 (88)	47 (6)	478 (57)	318 (38)	843 (113)
K. Jyoti								
NPK	7.7 (26)	17.9 (60)	4.3 (14)	29.9	57 (8)	323 (47)	306 (45)	686
P K	0.4 (4)	6.1 (66)	2.8 (30)	9.3 (31)	23 (5)	152 (33)	289 (62)	464 (68)
N K	6.1 (25)	15.2 (63)	2.9 (12)	24.2 (81)	44 (9)	261 (53)	184 (38)	489 (71)
N P	4.2 (18)	14.7 (63)	4.4 (19)	23.3 (78)	33 (6)	297 (50)	258 (44)	588 (86)

¹Rates of fertilizer were 240 kg N, 150 kg P₂O₅, and 180 kg K₂O per hectare

²Values within parentheses represent the percent of category total

³Values within parentheses represent the percent of NPK treatment

Plate 2. Nutrient deficiency at 70 days of plant growth of Kufri Sutlej potato.



significantly. However the extent of the increase varied with crop variety (Table 2). Nitrogen increased tuber yield of Kufri Sutlej, Jawahar and Jyoti by 23.9, 22.4 and 20.6 t/ha, respectively. The corresponding increase due to P and K was 8.3, 11.1 and 5.7 t/ha and 13.2, 4.5 and 6.6 t/ha, respectively. Yield reduction due to N, P and K deficiency was largest in Kufri Jyoti (69 percent), Jawahar (29 percent), and Sutlej (31 percent), respectively. Results also showed Kufri Sutlej and Jyoti were more responsive to N and K while Kufri Jawahar was more responsive to P. This differential responsiveness of potato varieties might be related to differences in plant height. Plant height was highest in Kufri Sutlej and lowest in Kufri Jawahar. Greater plant heights resulted in fewer shoot numbers (Kufri Sutlej and Jyoti) and subsequently resulted in larger N and K responses. In contrast, shorter plants had larger shoot numbers (Kufri Jawahar) and a larger P response.

Tuber Size

The effect of N, P and K on the grade (quality) of tubers also varied among varieties tested (Table 2). Nitrogen application increased yield of all Kufri Sutlej and Jawahar tuber grades. In Kufri Jyoti, N increased the yield of large and small sized tubers but decreased the yield of medium sized

tubers. Potassium application consistently increased the yield of large sized tubers across varieties, but the effect on yield of medium sized tubers differed with variety. In Kufri Sutlej and Jawahar, K decreased medium sized tuber yield but had the opposite effect with Kufri Jyoti.

Tuber Number

Kufri Jawahar produced the highest number of tubers, followed by Kufri Jyoti and Sutlej (Table 2). Nitrogen increased tuber number and this increase was most prominent with Kufri Jyoti followed by Kufri Jawahar and Sutlej. Nitrogen also modified the number of tubers in each grade. In Kufri Sutlej, N increased the number of large and small sized tubers whereas, in Kufri Jawahar and Jyoti, it increased the number of all grades. Phosphorus did not affect tuber numbers in Kufri Sutlej, but the numbers did increase in Kufri Jawahar and Jyoti by 90,000 and 197,000, respectively. In Kufri Jyoti, the increase was more pronounced in medium sized tubers. In Kufri Jawahar, it was more pronounced in large sized tubers. Potassium had little effect on total number of tubers in Kufri Sutlej but did decrease tuber numbers in Kufri Jawahar. Potassium decreased the number of medium sized tubers in Kufri Sutlej and Kufri Jawahar proving large sized tubers contributed most to the yield increase in these two varieties. On the other hand, K increased the number of all grades in Kufri Jyoti.

Conclusions

Differences in nutrient deficiency symptoms of potato varieties must be kept in mind while assessing their respective nutrient needs. Nitrogen deficiency in potato consisted of yellowing of leaves and stunted growth. Phosphorus deficiency symptoms varied with cultivar. Kufri Jawahar did not exhibit P deficiency symptoms on its leaves, but had less leaves and shoots. Kufri Jyoti and Sutlej showed upward curling of leaves. Kufri Badshah and Chandramukhi also exhibited leaf curling as well as reduced numbers of shoots and leaves. Potassium deficiency was more acute in Kufri Jyoti and developed as a dark green coloration on leaves. With time, a bluish tinge progressed to bronzing and scorching. Absence of N, P and K reduced tuber yield by 55 to 69, 19 to 29, and 12 to 31 percent, respectively. Kufri Jawahar was most responsive to P, whereas Kufri Sutlej and Jyoti were more responsive to both N and K. **BCI**



Plate 3. Nutrient deficiency at 70 days of plant growth of Kufri Jawahar potato.

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