

Effects of Time and Method of Application of Varying Levels of Nitrogen on Yield and Yield Attributes of Potato

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Field trials were conducted with cv. 'Kufri Chandramukhi' to study the responses of the potato to two levels of N (80, 120 kg/ha) and its time and method of application on red laterite soils of Bangalore. Nitrogen application increased the tuber yield significantly. It also increased the plant height, fresh weight of haulm and number of tubers/hill. Application of 80 kg N/ha i.e., 40 kg/ha applied to the soil at planting + 40 kg/ha applied to the soil at earthing up recorded the highest yield (281.9 q/ha) and appeared to be optimum dose. It was superior to 80 kg N/ha and 120 kg N/ha whole dose applied to the soil at planting.

Potato (*Solanum tuberosum* L.) is highly responsive to nitrogen application (Reddy and Rao, 1968; Grewal *et al.*, 1979; Krishnappa *et al.*, 1980). However, it should be in assimilable form and available continuously (Pushkarnath, 1976). One of the important considerations in the use of fertilizers is the time and the manner of application. The present study was undertaken to determine optimum level of nitrogen and best time and method of its application.

MATERIAL AND METHODS

Field trials involving varying levels, time and method of application of nitrogen were carried out at the Horticultural Research Station of the University of Agricultural Sciences, Bangalore during *rabi*, 1979-80 and 1980-81 in red laterite soils (organic carbon 0.44-0.47%, available P_2O_5 6.0-7.0 kg/ha and available K_2O 250-260 kg/ha and with pH 6.0-6.2). A total of seven treatments (Table 1) were distributed

in a randomised block design with four replications. P_2O_5 and K_2O at the rate of 100 kg/ha each were applied as basal dressing in the form of single superphosphate and muriate of potash respectively for all the experimental units. Urea as a source of nitrogen was mixed with single superphosphate and muriate of potash as per treatment schedule for soil application and were applied in soil furrows. Disease-free whole tubers (each tuber weighing 35-45 g) of cv. 'Kufri Chandramukhi' were planted at a spacing of 60×20 cm in a gross plot of 4.8×4.0 m².

In case of treatments with split doses of nitrogen, the second application was done 30 days after planting and the crop was uniformly earthed up. The first foliar spray of one per cent low-biuret urea solution was given 45 days after planting and subsequent sprays at 10 day intervals supplying ten kg N/ha in each spray. Recommended package of practices were adopted for the crop in both the seasons.

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Ten randomly selected plants were considered for recording observations, viz., plant height and number of tubers/hill. Fresh weight of haulm (at harvest) and yield data were recorded in both the years based on three distinctive grades of tubers, viz., with diameters above 51 mm (large), 26-50 mm (medium) and below 25 mm (small) and were analysed separately and also pooled.

RESULTS AND DISCUSSION

Total yield: The germination of seed tubers was 90.0-95.2 per cent in different treatments indicating that nitrogen had no influence on the germination percentage. This is in line with the observations of Mandal and Arora (1978). Higher yield of potato was obtained during 1979-80 compared to 1980-81. Variation in yields was due to certain agroclimatic conditions as evident from earlier work (Grewal, 1974). The application of nitrogen upto 80 kg/ha increased the potato yield significantly during both the years and also when yield data were also pooled (Table 1). These results are in agreement with the findings of Sikka *et al.*, (1975) and Krishnappa *et al.*, (1980). The application of 120 kg N/ha did not further increase the yield (T_4 , T_5 and T_6). Laughlin (1971) reported that application of higher dose of N at planting decreased vigour of potato plants resulting in lower yields. The application of 80 kg N/ha (T_1) enhanced the yield by 85.9 q/ha over the control (T_0) when the data were pooled. The responses were improved further by 11.4% due to split application of N, i.e., 40 kg N/ha applied to the soil at planting + 40 kg N/ha applied to the soil

at earthing up (T_2). Similar beneficial effects of split application of N were reported by Pushkarnath and Patil (1959) and Sikka and Singh (1969). Keeping in view the fertilizers saved and non-significant increase in yield in other treatments, application of 40 kg N/ha to the soil at planting + 40 kg N/ha applied to the soil at earthing up (T_2) recorded the highest yield and was the best among the treatments tried, indicating that 80 kg N/ha appeared to be the optimum dose.

Gradewise yield: Application of N increased the amount of large and medium sized tubers significantly, however, it had no influence on small sized tubers in both the seasons. Invariably more large and medium sized tubers were produced when N was applied in split doses (Table 2). Similar observations were reported by Reddy and Rao (1969), Sikka and Singh (1969) and Grewal *et al.* (1979).

Plant height: Application of N significantly increased the plant height at 40 and 60 days after planting except treatments 1 and 2 during 1979-80 (Table 3). Treatment 5 recorded highest plant height, while lowest was recorded by control at 40 and 60 days after planting in both the years. Pushkarnath (1976) inferred that vegetative growth of potato crop is generally influenced by N supply, which in turn has a direct relation on the synthesis of photosynthates, particularly the starch, the main constituent of potato tubers. Dayal *et al.* (1972) reported that yield of potato showed significant and positive correlation with the height of main shoot.

up (T_3). Similar beneficial split application of N were Pushkarnath and Patil (1959) and Singh (1969). Keeping fertilizers saved and non-increase in yield in other application of 40 kg N/ha at planting + 40 kg N to the soil at earthing recorded the highest yield the best among the treatments stating that 80 kg N/ha appeared the optimum dose.

Yield: Application of N the amount of large and sized tubers significantly, had no influence on small tubers in both the seasons. More large and medium sized tubers produced when N was split doses (Table 2). Similar results were reported by Reddy (1969), Sikka and Singh (1969) and *et al.* (1979).

Plant height: Application of N increased the plant height 60 days after planting except treatment 1 and 2 during 1979-80. Treatment 5 recorded highest height, while lowest was by control at 40 and 60 days after planting in both the years. Pushkarnath (1969) inferred that vegetative potato crop is generally influenced by supply, which in turn has relation on the synthesis of starch, particularly the starch, constituent of potato tubers. (1972) reported that yield showed significant and correlation with the height of the plant.

No. of tubers/hill: Number of tubers is one of the factors which influences the yield of potato (Dayal *et al.*, 1972; Maity and Chatterjee, 1977). Nitrogen application significantly increased the number of tubers/hill during both the years (Table 3). This is in line with the findings of Reddy and Rao (1968) and Mandal and Arora (1978). Nitrogen @ 120 kg/ha applied in three splits produced highest number of tubers/hill.

Fresh Weight of haulms: Significant differences were observed among the treatments in the production of fresh weight of haulms during both the years. Application of N produced more fresh weight of haulms whereas control produced the least. The results are in agreement with the findings of Rajat De and Singh (1959).

The studies revealed that N at 80 kg/ha appeared to be optimum and may be applied in two split doses, i. e., 40 kg/ha at planting and 40 kg/ha at earthing up to obtain higher yields on red laterite soils of Bangalore.

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TABLE 1 Effects of time and method of application of nitrogen on total yield of potato (q/ha)

Treatments	1979-80	1980-81	Pooled	Per cent increase over control
T ₀ : Control (No application of N)	191.5	160.2	175.8	—
T ₁ : 80 kg N/ha applied to the soil at planting	306.0	217.4	261.7	48.9
T ₂ : 40 kg N/ha applied to the soil at planting + 40 kg N/ha applied to the soil at earthing up	316.8	247.1	281.9	60.3
T ₃ : 40 kg N/ha applied to the soil at planting + 20 kg N/ha to the soil at earthing up + 20 kg N/ha to the foliage in two equal sprays.	299.0	229.6	264.3	50.3
T ₄ : 120 kg N/ha applied to the soil at planting	299.3	196.6	247.9	41.0
T ₅ : 60 kg N/ha applied to the soil at planting + 60 kg N/ha applied to the soil at earthing up	317.6	233.4	275.5	56.7
T ₆ : 60 kg N /ha applied to the soil at planting + 40 kg N/ha applied to the soil at earthing up + 20 kg N/ha to the foliage in two equal sprays	320.5	224.9	272.7	55.1
C. D. (P=0.05)	37.1	34.8	47.3	—
C. V. (%)	8.6	10.9	9.2	—

TABLE 2 Effects of time and method of application of nitrogen on gradewise tuber of potato (q/ha)

Pooled	Per cent increase over control
175.8	—
261.7	48.9
281.9	60.3
264.3	50.3
247.9	41.0
275.5	56.7
272.7	55.1
47.3	—
9.2	—

Treatments	Large size		Medium size		Small size	
	1979-80	1980-81	1979-80	1980-81	1979-80	1980-81
T ₀	65.8	41.6	124.8	117.8	0.9	0.8
T ₁	129.6	76.5	175.5	140.0	0.9	0.9
T ₂	143.3	89.2	172.4	157.2	1.1	0.7
T ₃	101.3	69.7	196.9	159.2	0.8	0.7
T ₄	131.9	79.1	166.5	116.7	0.9	0.8
T ₅	129.4	82.2	187.3	150.2	0.9	1.0
T ₆	131.7	76.4	187.7	147.5	1.2	1.0
C. D. (P=0.05)	34.5	11.1	33.2	29.0	N.S.	N.S.
C. V. (%)	20.5	16.7	12.9	13.8	—	—

N. S.=Non-Significant

TABLE 3 Influences of time and method of application of nitrogen on certain yield attributes

Treatments	Plant height (cm)				No. of tubers/hill at harvest		Fresh weight of haulms at harvest (kg/plot)	
	40 days		60 days		1979-80	1980-81	1979-80	1980-81
	1979-80	1980-81	After planting 1979-80	1980-81				
T ₀	34.4	21.7	43.7	23.3	6.1	4.4	9.4	3.7
T ₁	37.1	28.7	54.3	30.7	7.4	5.1	15.5	8.4
T ₂	37.6	28.1	56.9	31.0	8.4	5.8	18.9	12.3
T ₃	38.3	28.4	53.3	31.2	7.2	5.2	18.5	11.5
T ₄	41.0	28.1	53.8	31.8	7.2	5.3	17.1	12.6
T ₅	39.9	30.2	58.2	32.9	7.8	5.9	20.4	11.7
T ₆	38.4	29.8	56.9	32.5	10.8	6.2	21.7	14.2
C. D. (P=0.05)	3.4	5.0	6.9	5.0	1.0	0.3	5.0	1.9
C. V. (%)	5.9	12.2	8.7	11.2	9.8	3.7	19.5	12.0