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Response of potato variety Kufri Jyoti to different levels of NPK and their cost economics in southern dry zone of Karnataka

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Abstract
An experiment was conducted on standardization of site specific NPK requirements for potato variety Kufri Jyoti at HRES, Hassan for three years during *Kharif* season of 2015-18. The research was initiated with seven treatments *viz*., T_1-RDF -50 per cent NPK, T_2-RDF-100 per cent NPK, T_3-RDF-150 per cent NPK, T_4-without N, T_5-without P, T_6-without K and T_7-without NPK as check. An experiment was laid out in RCBD with three replications by adopting 60 cm x 20 cm spacing. The fertilizers were applied based on the recommended dose of fertilizer of 75:75:100 kg NPK per ha with FYM at 25 tons per ha. The results indicated that, treatment with RDF at 150 per cent of NPK fertilizers resulted significantly highest total tuber yield of 15.86 t/ha with B: C ratio of 1.61 followed by RDF at 100 per cent NPK recorded 13.75 t/ha and B: C ratio of 1.49 as compared to other treatments. Therefore it was indicated that application of higher dose of 150 per cent NPK, crop was responded progressively in terms of producing highest tuber yield and net returns.

Keywords: Kufri Jyoti, Kharif, NPK, Yield, B:C ratio

Introduction
Potato (*Solanum tuberosum* L.) belongs to family Solanaceae and is one of the most important vegetable cum starch supplying crop having high production per unit area and time. Potato is an underground tuber crop occupies prime position among the cash crops in India and it can fulfill the requirement of food for human consumption to a greater extent (Banjare *et al*., 2014) [1]. The growth, development and yield of potato is mainly governed by availability of major nutrients required for its cultivation. Therefore, supply of major nutrients play an vital role in growth and yield. However, inadequate and indiscriminate use of fertilizers can also be the main reason for the low yields in potato. Among the major nutrients, nitrogen is the first limiting factor for potato crop production and is an essential constituent of protein and chlorophyll pigment which improves vegetative growth and invariably increases yield, tubers per plant, tuber size as well as tuber numbers. Whereas, phosphorous nutrient contributes towards early crop development, tuberization and enhances tuber maturation. While, potassium element influences both yield and tuber quality, besides enhances plant resistance to withstand stress against drought and frost (Nizamuddin *et al*., 2003) [5].
Of different agronomic practices, the macro-nutrients management (especially N, P and K) is the most important factor for harnessing the full production potential of any potato cultivar (Kumar *et al.*, 2004) [3] and use of balanced fertilizer is important for boosting up the yield. Also, the response of these macro-nutrients are known to vary considerably with variety and locality (Ravikant and Chadha, 2009) [6]. Therefore with this back ground the present study was initiated to standardize the N, P and K levels for maximizing the yield of potato variety Kufri Jyoti in southern dry zone of Karnataka.

Materials and Methods
An experiment was conducted on standardization of site specific NPK requirements for potato variety Kufri Jyoti at HRES, Hassan consecutively for three years during *Kharif* season of 2015-16, 2016-17 and 2017-18. The research was initiated with seven treatments *viz*., T_1-RDF -50 per cent NPK, T_2-RDF-100 per cent NPK, T_3-RDF-150 per cent NPK, T_4-without N, T_5-without P, T_6-without K and T_7-without NPK as check. An experiment was laid out by using RCBD with three replications.

The land was prepared for the research before sowing and FYM @ 25 t/ha was incorporated into soil. The tuber sowing was taken up during the first week of June in all three years by adopting scientific spacing of 60 cm x 20cm. The recommended dosage of NPK 75:75:100 kg/ha was applied during cropping season. From the recommended quantity of nitrogen, 50 per cent of nitrogen was applied at sowing and remaining 50 per cent of nitrogen was supplemented after 30 days of sowing at earthing-up operation. A straight fertilizers like Urea for nitrogen, Single Super Phosphate for phosphorous and Murate of Potash for potassium were used for imposing in different treatments. The package of practices of UHS, Bagalkot was followed during different stages of crop growth and harvesting was done at 90 days after sowing. The observations related to yield parameters and tuber weight of four grades *viz*., >75 g (A-grade), 51-75 g (B-grade), 26-50g (C- grade) and <25 g (D- grade) were recorded on plot wise and later transformed to tones per hectare. The marketable tuber yield was computed by adding A, B and C grade tubers, unmarketable was D-grade and total tuber yield was calculated by adding all four grades of tubers. The main objective was to study the effect of different levels of NPK on the yield of potato crop and also to compare the expected returns from different treatments. The yield data under each treatment was recorded for three consecutive years and data was analysed statistically. Further, cost economics was calculated year wise to check for B: C ratio.

Results and Discussion

The pooled data on yield parameters indicated that among all the treatments, highest tuber yield with large sized tubers (>75 g tubers) were documented in treatment with 150 per cent RDF of NPK (6.58 t/ha) followed by the treatment with 100 per cent RDF of NPK (5.88 t/ha). However, least tuber yield (3.54 t/ha) was noticed in control without NPK. Kumar *et al*., (2001) [4] reported similar type of results that significant increase in yield from 100 to 150 per cent of all grades was recorded with increase in recommended dosage of NPK. The highest marketable tuber yield was registered in treatment with 150 per cent RDF of NPK (13.79 t/ha) followed by treatment at 100 per cent RDF of NPK with 12.10 t/ha. Besides, highest unmarketable tuber yield also noticed at 150 per cent of NPK with 3.36 t/ha followed by 2.67 t/ha obtained at 100 per cent NPK. Similarly, total tuber yield of 15.86 t/ha was documented in treatment with 150 per cent RDF of NPK followed by 13.75 t/ha in the treatment of per cent RDF of NPK and lowest yield was recorded in check of without NPK (7.58 t/ha). The better responses and trends were observed with the increase in fertilizers. All treatments showed considerable yield increase with increase in fertilizer dosage, similar trends were also concluded by Khan et al., 1993 [2], Nizamuddin *et al*., 2003 [5], Shunka *et al*., 2016 [8], Sultan *et al*., 1989 [9]. The results of this study revealed that the fertilizer dose of 150 per cent RDF NPK (112.5:112.5:150) was found suitable for getting maximum tuber yield in southern dry zone of Karnataka.

In all the three consecutive years cost economics was worked out to compute both gross and net income per hectare and recorded highest in soil application of 150 per cent of recommended dosage of fertilizers of NPK treatments followed by 100 percent RDF of NPK as compared to other treatments (Table 3, 4 & 5). The pooled data of cost benefit ratio from different fertilizer applications varied between 0.94 to 1.61 in accordance with the prevailing market prices. The treatment with 150 per cent RDF of NPK showed significantly out yielded over control, gave comparatively higher yield than other treatments and also documented highest cost benefit ratio of 1.61 followed by treatment with 100 per cent RDF of NPK (1.49). Similar trends were also noticed by Shah and Ismail 1983 [7].

Table 1: Effect of different levels of NPK on grade wise tuber yield (t/ha) of potato in *Kharif* season

Treatment details	>75 g tubers (t/ha) (A-grade)				50-75 g tubers (t/ha) (B-grade)				26-50 g tubers (t/ha) (C-grade)				<25 g tubers (t/ha) (D-grade)			
	2015	2016	2017	Pooled	2015	2016	2017	Pooled	2015	2016	2017	Pooled	2015	2016	2017	Pooled
T-1 : 50% RDF of NPK	2.44	7.14	4.23	4.60	2.04	3.48	1.78	2.43	2.20	1.94	0.77	1.64	2.09	0.72	2.75	1.85
T-2 : 100% RDF of NPK	2.93	10.07	4.63	5.88	2.49	6.01	3.22	3.91	2.37	2.93	1.66	2.32	2.39	1.49	4.14	2.67
T-3: 150% RDF of NPK	3.12	11.42	5.20	6.58	2.97	7.50	3.42	4.63	2.70	3.29	1.75	2.58	3.02	1.88	5.19	3.36
T-4: without N	1.93	7.94	3.52	4.46	1.53	3.89	1.88	2.43	2.43	2.14	1.10	1.89	2.03	0.88	2.74	1.88
T-5 : without P	2.72	8.89	4.47	5.36	2.31	5.51	2.50	3.44	2.33	2.68	1.34	2.12	2.13	1.12	2.79	2.01
T-6: without K	1.60	8.47	3.15	4.41	2.42	4.32	1.48	2.74	2.20	2.42	1.10	1.91	2.30	1.02	3.02	2.11
T-7: without NPK	1.91	6.06	2.64	3.54	1.50	2.38	1.43	1.77	1.98	1.58	0.66	1.41	1.44	0.51	2.64	1.53
S Em+	0.26	0.41	0.11	0.45	0.35	0.30	0.08	0.41	0.33	0.13	0.07	0.13	0.34	0.08	0.07	0.20
CD(p=0.05)	0.53	1.22	0.33	1.37	0.77	0.90	0.22	1.25	0.67	0.38	0.19	0.39	0.74	0.24	0.22	0.62
CV (5%)	11.94	9.62	5.51	15.52	18.00	13.00	6.72	23.07	16.35	10.61	8.40	11.00	18.28	14.79	17.70	15.75

Table 2: Effect of different levels of NPK on marketable, un-marketable and total tuber yield (t/ha) of potato in *Kharif* season

Treatment details	Marketable tuber yield (t/ha)				Un-marketable tuber yield (t/ha)				Total tuber yield (t/ha)				B:C ratio			
	2015	2016	2017	Pooled	2015	2016	2017	Pooled	2015	2016	2017	Pooled	2015	2016	2017	Pooled
T-1 : 50% RDF of NPK	6.68	12.56	6.78	8.67	2.09	0.72	2.75	1.85	8.77	13.28	7.47	9.84	0.99	1.49	0.84	1.11
T-2 : 100% RDF of NPK	7.79	19.01	9.51	12.10	2.39	1.49	4.14	2.67	10.20	20.49	10.55	13.75	1.10	2.22	1.14	1.49
T-3: 150% RDF of NPK	8.79	22.21	10.37	13.79	3.02	1.88	5.19	3.36	11.80	24.09	11.68	15.86	1.23	2.37	1.22	1.61
T-4: without N	5.89	13.97	6.5	8.79	2.03	0.88	2.74	1.88	7.92	14.85	7.19	9.99	0.86	1.62	0.78	1.09
T-5 : without P	7.36	17.08	8.31	10.92	2.13	1.12	2.79	2.01	9.48	18.20	9.01	12.23	1.07	2.05	1.01	1.38
T-6: without K	6.22	15.21	5.73	9.05	2.30	1.02	3.02	2.11	8.52	16.22	6.48	10.41	0.95	1.81	0.72	1.16
T-7: without NPK	5.39	10.02	4.73	6.71	1.44	0.51	2.64	1.53	6.83	10.53	5.39	7.58	0.78	1.35	0.69	0.94
S Em+	0.18	0.40	0.21	0.92	0.34	0.08	0.07	0.20	0.49	7.47	0.14	0.95	-	-	-	-
CD(p=0.05)	0.56	1.22	0.64	2.84	0.74	0.24	0.22	0.62	1.08	10.55	0.40	2.94	-	-	-	-
CV (5%)	13.86	13.12	14.45	15.94	18.28	14.79	17.70	15.75	6.36	11.68	5.55	14.52	-	-	-	-

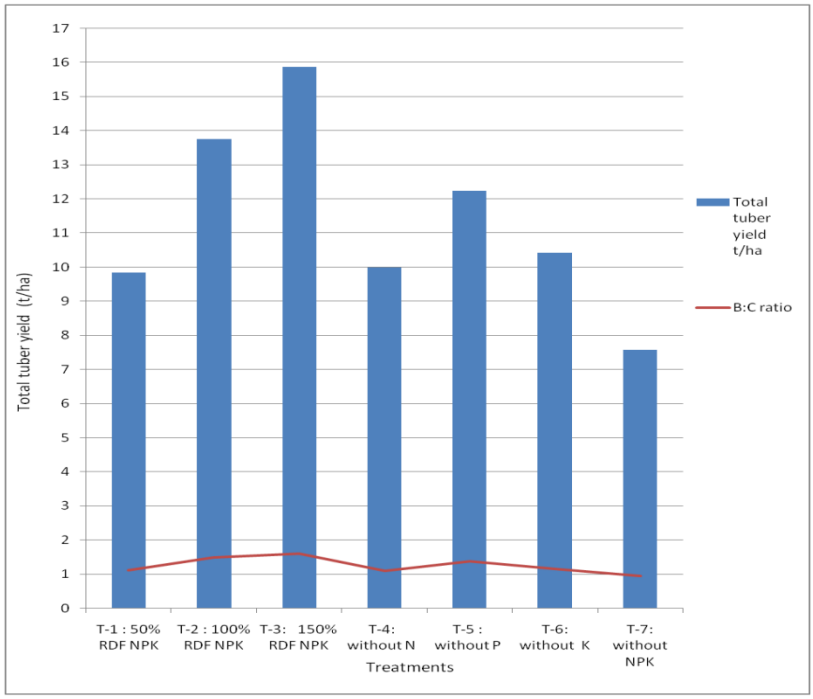

Fig 1: Total tuber yield (t/ha) and B: C ratio of different levels of NPK treatments

Table 3: Cost economics for different levels of NPK fertilizers in *Kharif* season per hectare (2015-16)

Treatment details	Tuber Yield (t/ha)	Cost of cultivation (Rs./ha)				Income (Rs./ha)		B:C Ratio
		Seed tuber Cost	Fertilizers + Pesticides Cost	Cultivation Cost	Total Expenditure	Gross Income	Net Income	
T-1 : 50% RDF of NPK	8.77	22,500	13,550	52,900	88,950	87,700	-1,250	0.99
T-2 : 100% RDF of NPK	10.19	22,500	17,100	52,900	92,500	1,01,900	9,391	1.10
T-3: 150% RDF of NPK	11.80	22,500	20,650	52,900	96,050	1,18,000	21,950	1.23
T-4: without N	7.92	22,500	16,338	52,900	91,738	79,200	-12,588	0.86
T-5 : without P	9.48	22,500	13,443	52,900	88,843	94,750	5,907	1.07
T-6: without K	8.52	22,500	14,420	52,900	89,820	85,160	-4,660	0.95
T-7: without NPK	6.83	22,500	10,000	55,420	87,920	68,300	-19,620	0.78

Note: Seed Rate - 1500 kg/ha, Seed Tuber Cost - Rs. 15/kg, Market Sale Price -Rs. 10/kg

Table 4: Cost economics for different levels of NPK fertilizers in *Kharif* season per hectare (2016-17)

Treatment details	Tuber Yield (t/ha)	Cost of cultivation (Rs./ha)				Income (Rs./ha)		B:C Ratio
		Seed tuber Cost	Fertilizers + Pesticides Cost	Cultivation Cost	Total Expenditure	Gross Income	Net Income	
T-1 : 50% RDF of NPK	13.28	22,500	13,550	52,900	88,950	1,32,800	44,050	1.49
T-2 : 100% RDF of NPK	20.49	22,500	17,100	52,900	92,500	2,04,900	1,12,400	2.22
T-3: 150% RDF of NPK	24.09	22,500	20,650	52900	96,050	2,40,900	1,44,850	2.51
T-4: without N	14.85	22,500	16,338	52,900	91,738	1,48,500	56,762	1.62
T-5 : without P	18.20	22,500	13,443	52,900	88,843	1,82,000	93,157	2.05
T-6: without K	16.22	22,500	14,420	52,900	89,820	1,62,200	72,380	1.81
T-7: without NPK	10.53	22,500	10,000	45,420	77,920	1,05,300	27,380	1.35

Note: Seed Rate - 1500 kg/ha, Seed Tuber Cost - Rs. 15/kg, Market Sale Price -Rs. 10/kg

Table 5: Cost economics for different levels of NPK fertilizers in *Kharif* season per hectare (2017-18)

Treatment details	Tuber Yield (t/ha)	Cost of cultivation (Rs./ha)				Income (Rs./ha)		B:C Ratio
		Seed tuber Cost	Fertilizers + Pesticides Cost	Cultivation Cost	Total Expenditure	Gross Income	Net Income	
T-1 : 50% RDF of NPK	7.47	22,500	13,550	52,900	88,950	74,700	-14250	0.84
T-2 : 100% RDF of NPK	10.55	22,500	17,100	52,900	92,500	1,05,500	13000	1.14
T-3: 150% RDF of NPK	11.68	22,500	20,650	52900	96,050	1,16,800	20750	1.22
T-4: without N	7.19	22,500	16,338	52,900	91,738	71,900	-19838	0.78
T-5 : without P	9.01	22,500	13,443	52,900	88,843	90,100	1257	1.01
T-6: without K	6.48	22,500	14,420	52,900	89,820	64,800	-25020	0.72
T-7: without NPK	5.39	22,500	10,000	45,420	77,920	53,900	-24020	0.69

Note: Seed Rate - 1500 kg/ha, Seed Tuber Cost - Rs. 15/kg, Market Sale Price -Rs. 10/kg

Plate 1: Showing best performed treatments of soil application of 150 per cent and 100 per cent RDF of NPK levels

Conclusion

The results of this study showed that the variety Kufri Jyoti responds to higher levels of NPK application and resulted corresponding increase in yield with higher net returns. However, better responses and trends were observed with the use of 150 per cent recommended dose of higher levels of NPK fertilizers under the soil conditions prevailing in southern dry zone of Karnataka. The existing profitability levels in potato cultivation can be considerably enhanced through judicious application of NPK fertilizers.

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