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Effect of integrated nutrient management on soil and plant nutrient content in potato (*Solanum tuberosum* L)

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Abstract
The present study was conducted to investigate the "Effect of integrated nutrient management on growth, yield and quality of potato". Experiment was laid out in the randomized block design with 14 treatments. The results revealed that application of *Azotobacter* + PSB + KSB + $MgSO_4$ + micro nutrient mixture + 75 % RDF (T_{13}) recorded significantly maximum soil available N (400 Kg/ha), P (62.33 Kg/ha) and K (294.67 Kg/ha), EC (0.74 ds/m), PH (4.87) and OC (0.94 %), leaf tissue nitrogen (1.85 %), leaf tissue phosphorous (1.36 %) and leaf tissue potassium (2.83 %) while minimum values were found in the control.

Keywords: Potato, soil available nutrients, leaf tissue N, P and K

Introduction
Potato (*Solanum tuberosum* L) native to tropical South America and one of the most efficient food crop which produces more dry matter, dietary fibre, quality protein, minerals, vitamins and richest source of energy. The area and production of potato in the country is estimated around 20.85 lakh hectares and 480.96 lakh million tonnes, respectively with the productivity of 23.07 tonnes per hectare [1]. Integrated supply of nutrients through organic, inorganic and bio fertilizers is the need of the hour for sustainable productivity and to maintain better soil health [2]. Potato demands high level of soil nutrients due to relative poorly developed and shallow root system [3]. Compared with cereal crops, potato produces much more dry matter in a shorter cycle [4]. This high rate of dry matter production results in large amount of nutrients removed per unit time from per unit area, which generally most of the soils are not able to supply. Hence, nutrient application from external sources as fertilizers becomes essential. High yields can only be sustained through the application of optimal NPK dose in balanced proportion. Nitrogen, phosphorus and potassium are the major nutrients affecting growth, development and yield of potato. Nitrogen being constituent of protoplasm which enhances chlorophyll synthesis. The phosphorus has a direct impact on shoot growth, root development and tuber formation in potato whereas, potassium is one of the important constituent of cell and its deficiency has adverse effect on quality of tuber.
Thus, the possibility for the use of organic fertilizer alone or in combination with inorganic fertilizer is to be explored in order to maintain soil health and crop productivity. The production and productivity of the potato crop are far below in the country due to lack of proper management practices. Among which balanced nutrition is one of the most important factor that affecting the growth and productivity of potato. Therefore, present study was conducted to ensure the nutrient requirement of the crop by integration of organic, inorganic and biofertilizers which helps not only to increase the yield but also maintains the soil health and eco-friendly environment.

Material and Methods
The experiment was conducted at department of vegetable science in College of Horticulture, Mudigere. The experiment was conducted in RCBD design with 14 treatments replicated thrice. The experimental details is as follows: T_1 – control (RDF:125:100:125 Kg/ha + FYM 25 t/ha), T_2 -75% RDF + Vermicompost (2.5 t/ha), T_3-75% RDF + Vermicompost + *Azotobacter*, T_4- 100% RDF + *Azotobacter*, T_5 - 75% N + RD of P and K +*Azotobacter*

T_6 -100% RDF +PSB, T_7- 75% P+ RD of N and K + PSB, T_8 - 100% RDF +KSB, T_9 - 75% K + RD of N and P + KSB, T_{10} - 50% RDF + VC+ *Azotobacter* +PSB +KSB, T_{11}- T_{10} + $MgSO_4$ + Micronutrient mixture, T_{12} - 75% RDF + *Azotobacter* + PSB + KSB, T_{13}- T_{12}+ $MgSO_4$+ Micronutrient mixture, T_{14}- RDF + $MgSO_4$ + Micronutrient mixture. Soil available nitrogen was found out by alkaline permanganate method [5], phosphorous by colorimetric method [6], potassium by flame photometer [7], PH (PH meter), EC (conductivity bridge), OC (Walkey and Blacks method) given by [8]. The leaf tissue Nitrogen, phosphorus and potassium content in samples were estimated by Micro- Kjeldahl method, Vanadomolybdate phosphoric yellow color method and Flame photometric method, respectively [8].

Result and Discussion

The data on the available nitrogen, phosphorous, potassium of the soil as influenced by integrated nutrient management practices is presented in table 1. Significantly the highest available Nitrogen, phosphorous and potasium in the soil (400.00, 62.33 and 294.67 kg/ha) was recorded with the treatment T_{13} (*Azotobacter* + PSB + KSB + 75 % RDF + $MgSO_4$ + Micronutrient mixture) and it was on par with treatment $T_{11,}$ T_{14} and T_{12} respectively. The data on the EC, PH and OC as influenced by integrated nutrient management practices is also presented in Table 1. Significantly the highest EC, PH and OC of the soil (0.74 dsm^{-1}, 4.87, 0.94 %) was observed with the treatment T_{13} (*Azotobacter* + PSB + KSB + 75 % RDF + $MgSO_4$ + Micronutrient mixture) and it was on par with treatment T_{11}, T_{14} and T_{12}. However, lowest N, P, K, PH, EC and OC were found in the control. The increased nitrogen status of soil was due to use of organic manures, especially FYM and balance use of chemical fertilizers [9]. The build-up of available phosphorus and potassium in the soil could be due to the organic acids which were released by increased microbial population in soil by the application of PSB and KSB. [10] reported that combined application of biofertilizers + 50 per cent inorganic fertilizers + 50 per cent FYM in chilli increased the soil N, P and K availability (290:14.5:228 kg/ha, respectively). Similar findings were also reported by [11] in chilli. Similarly the highest EC, PH and organic carbon content (0.74 ds/m, 4.87, 0.94 % respectively) were recorded in the treatment with the combination of *Azotobacter* + PSB + KSB + 75 per cent RDF + $MgSO_4$ + Micronutrient mixture (T_{13}) and the lowest available nitrogen was recorded in the control RDF + FYM (T_1).

The data on the nitrogen, phosphorous and potassium content of the leaf as influenced by integrated nutrient management practices is presented in figure 1. Nitrogen content in the leaf differed significantly, the highest nitrogen, phosphorous and potassium content is found in the treatment (T_{13}) supplied with the combination of *Azotobacter* + PSB + KSB + $MgSO_4$ + Micro nutrient mixture + 75 % RDF (1.85 %, 1.36 % and 2.83 %, respectively). The minimum nitrogen content of N, P and K was found in the control. The probable reason for recording higher nutrient content in leaves of potato may be due to the synergetic effect of organic and inorganic fertilizers lead to the accumulation of more nutrients during the crop growth period as compared to RDF (T_1). Similar results were reported by [12].

Table 1: Effect of INM on soil available nutrient status and chemical parameters in potato

Treatments	N (Kg/ha)	P (Kg/ha)	K (Kg/ha)	E C (ds/m)	pH	OC (%)
T_1	254.97	31.00	141.67	0.50	4.30	0.66
T_2	290.78	34.78	170.35	0.52	4.43	0.67
T_3	303.44	40.09	173.33	0.54	4.60	0.71
T_4	333.05	46.67	206.67	0.58	4.70	0.80
T_5	325.78	41.96	203.33	0.62	4.50	0.78
T_6	339.84	42.00	204.33	0.86	4.54	0.79
T_7	332.34	31.00	204.00	0.50	4.52	0.81
T_8	337.23	52.00	209.67	0.52	4.56	0.78
T_9	309.76	28.00	209.00	0.62	4.53	0.76
T_{10}	363.73	23.00	250.00	0.60	4.72	0.57
T_{11}	361.33	61.67	296.00	0.73	4.85	0.89
T_{12}	318.14	59.33	291.00	0.61	4.80	0.84
T_{13}	400.00	65.33	296.82	0.74	4.87	0.94
T_{14}	320.00	62.33	294.67	0.65	4.82	0.87
S. E m±	17.41	2.93	10.95	0.04	0.10	0.05
CD @5%	50.60	8.53	31.83	0.12	0.30	0.15

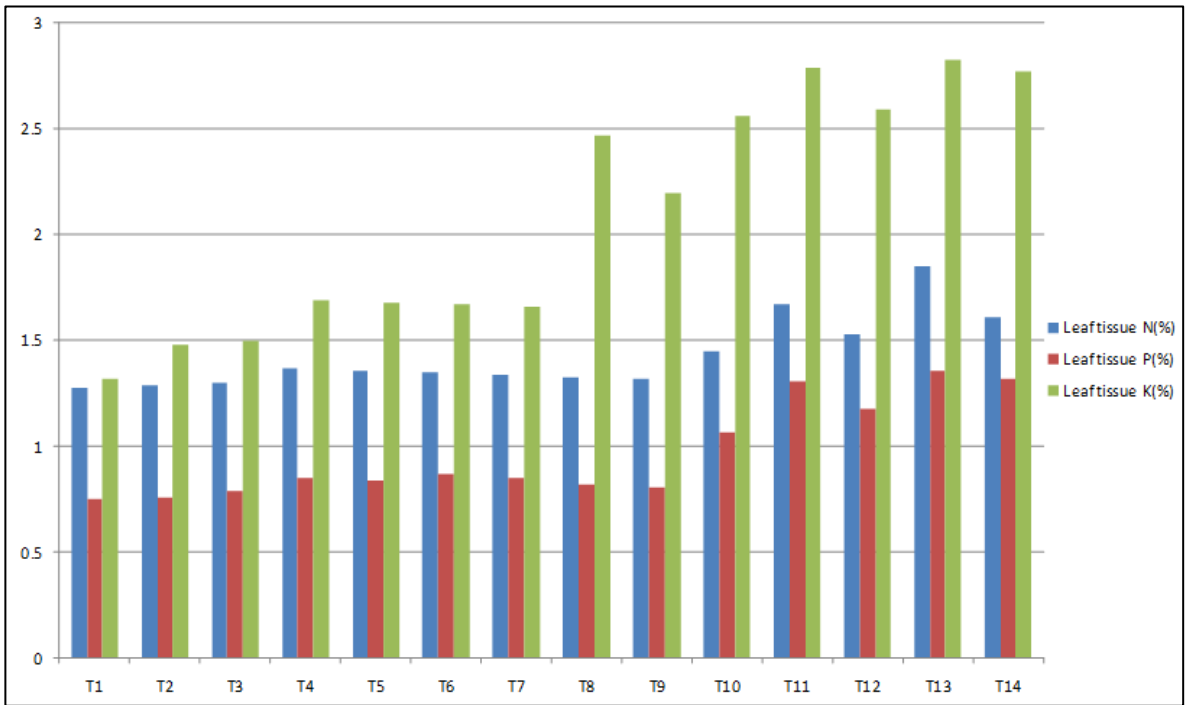

Fig 1: Effect of INM on leaf nutrient content in potato

Conclusion

It can be concluded that combined application of 75 % RDF + Azotobacter + PSB + KSB + $MgSO_4$ + Micronutrient mixture (T_{13}) showed significantly highest soil available nitrogen, phosphorous, potassium, PH, EC and OC. Similarly leaf tissue N, P and K were also found maximum in the same treatment.

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