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Productivity and economic potentials of tuber treatments supplemented with N and P fertilization in potato (*Solanum tuberosum* L.) in Eastern Bihar plains

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ABSTRACT

Experiment involving tuber treatments supplemented with N and P fertilization in potato (*Solanum tuberosum* L.) was conducted in Eastern Bihar plains to study its productive and economic potential in terms of benefits in yield and economy in fertilizer use with other contributions viz., soil fertility and nutrient removal. The study under reference was undertaken on potato cv. Kufri Jyoti during *rabi* 1999-00 and 2000-01 in a sandy clay loam soil, low in O.C. & N, and medium in P & K. Results revealed that dipping of planting materials (tubers) with 1% each of urea and sodium bicarbonate along with tuber treatment with both *Azotobacter* and *Azophos* resulted in highest productivity and greater economic benefits both in fertilizer use and net return. Newer strain of *Bacillus* viz., *B. cereus* was found to be more effective in nutrient mobilization, crop growth, tuber productivity with more economic benefits in comparison to its counterpart i,e., *B. subtilis*. Although higher productivity was realized with higher NPK combinations yet the combined application of the followings viz., tuber dipping in 1% urea and sodium carbonate along with *Azotobacter* and *Azophos* supplemented with low NPK might be the cost saving proposition. The present findings suggests that dipping of tubers with 1% each of urea and $NaHCO_3$ along with tuber treatment with both *Azotobacter* and *Azophos* supplemented with 25 % reduction in normal requirement of N & P may be essential for realization of optimum productivity and economic potential in the potato crop in Bihar plains.

Key words : Potato, Tuber treatments, N & P fertilizers, *Azotobacter*, *Azophos* , *Bacillus,* Yield, Nutrient uptake, Economics, Soil fertility.

INTRODUCTION

Recognition of potato (*Solanum tuberosum L.)* as a nutritionally fourth valuable food crop of the world after rice, wheat and maize, has facilitated to sustain and diversify the food production in this new millennium. In the developing country like India, the crop has substantially contributed to sustaining the food productions over the last five decades; and its nutritionally superiority with favorable protein-carbohydrate balance and high quality protein have made the crop more wholesome in its consumption and raised the demand for the crop both within and outside the country. Figures in 2004 reveals that India's production touched to 25 m tonnes of potatoes only from 1.40 m hectares with the productivity of 178.6 q/ha (Pandey and Sarkar, 2005). Keeping in view its importance in food security and the ever increasing demand for the commodity, both the production and productivity have to be raised at the growth rate of 3.10 and 1.89 % respectively towards 2020 with the target of 37.3 m tonnes from nearly the same area with productivity of 259 q/ha. In addition, with escalating cost of inputs that eats out the margins in production, newer challenges/limitations are emerging in for maintaining the tempo of sustaining both its production & productivity, and making the commodity more remunerative.

One of the major limitation in our effort to sustain the performance of the crop is agro-technological that includes the twin problems viz., lack of availability of good quality planting materials and poor crop management including that of input and its cost. Therefore, in presence of goods quality seeds, emphasis on low cost sustainable technologies vis-a-vis use of alternative biological sources for inorganic fertilizers provides necessary impetus so as to make the crop more competitive and productive with regard to both input cost and profit margin. Simple techniques of seed treatments involving very low costs but virulent microbes along with initial nourishments of planting materials *in situ* might sustain both productivity and economic viability via. enhanced nutrient solubility and mobilization. More critically, the benefits accruing from the use of such environmentally friendly microbes viz.,*Azotobacter, Azophos* and *Bacillus* supplemented with N & P nutrition of the crop will ease the stress in cost of cultivation besides accruing gain in output quality and quantity (Sharma et al. 1997). Thus, extrapolating such a benefit further, study was conducted to ascertain the productivity and economic potentials of tuber treatments supplemented with N and P fertilization in potato (*Solanum tuberosum* L.) in relatively untapped regions of Bihar plains under Eastern Indo-Gangetic Plains.

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MATERIALS AND METHODS

Field experiment with *Azotobacter* for nitrogen & *Azophos* for phosphorus and growth promoting (PGB) bacteria (*Bacillus subtilis* and *Bacillus cereus*) along with urea and single super phosphate as common sources for N & P, was conducted using potato cv. Kufri Jyoti for two years during *rabi,* 1999-00 and 2000-01 at Central Potato research Station, Patna under South Bihar alluvial plain sub-region of Bihar. The experimental sandy clay loam soils was low in O.C. (0.31%), total N (387 ppm) & available N (109 ppm), and medium in available P (9.4 ppm) & K (121 ppm) and was slightly alkaline (pH of 7.9).

The treatment combinations comprising of five different tuber treatments and two levels of N & P fertilizer combinations were tried in factorial R.B.D. with four replications. Tuber treatments include control (sprouted tubers planted as such, $\mathbf{T_1}$), dipping in solutions containing 1 % urea and 1% sodium bicarbonate ($NaHCO_3$) for 5 minutes ($\mathbf{T_2}$), dipping as in T_2 along with tuber treatment of both *Azotobacter* sp. and *Azophos* sp. (IARI strains,$\mathbf{T_3}$), application of *Bacillus subtilis* (strain B5, $\mathbf{T_4}$) and application of *Bacillus cereus* ($\mathbf{T_5}$, strain B4; both B_4 & B_5 were CPRIC, Modipuram strains). The N & P applications included variable N & P fertilizers viz., 100 % recommended dose, for N & P (**NP**) i.e., 180 kg Urea-N & and 60 kg SSP-P_2O_5) and 75 % of recommended dose for N & P (**75 % NP**). Potassium @ 100 kg/ha in terms of MOP-K_2O was applied uniformly in all the plots at planting along with whole quantity of Phosphorus. Only nitrogen was applied as half at planting and half at earthing up.

Method for tuber treatments

The required planting material i.e., healthy tubers (40 g each) of cv. Kufri Jyoti with sprouts of 2-3 mm, was divided into 5 lots. One lot of seed materials was kept as such without any treatment (control, $\mathbf{T_1}$). The second lot of tubers was dipped and allowed to soak in 1 % each of urea and $NaHCO_3$ solution (400 g each of the chemical dissolved in 40 litres of potable water) for 5 minutes and allowed to dry in shade ($\mathbf{T_2}$). The third lot of tubers was subjected to similar treatment as in T_2 but was partially dried in the shade. For tuber treatment with *Azotobacter and Azophos*, 200 g of each of above ash-based bio-formulations (sufficient for one acre) were added to a *jaggery* solution (100 g of *jaggery / gur* in one litre of