



Production Potential and Economics of Nutrients management in Potato based most popular cropping system in Central Plain Zone of Uttar Pradesh

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Abstract:

A field experiment was conducted during Rabi season of 2019-20 and 2020-21 at Vegetable Research Farm, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur (U.P) India to judge the effect of nutrients application on potato based most popular cropping system on the pooled basis. The experiment was laid out in Randomized Block Design with three replication. The total treatment combinations were eight treatment in the field experimentation viz. R-R-R (T_1), R-R-ST(T_2), R-ST-R (T_3), R-ST-ST(T_4), ST-R-R(T_5), ST-ST-R (T_6), ST-R-ST(T_7) and ST-ST-ST(T_8) in which 'R' means recommended NPK and 'ST' means NPK applied on soil test basis. The results revealed that the economics is the main concern, green gram-potato-maize based cropping system recorded highest potato equivalent yield (62947.67 kg/ha) by R-ST-R (T_3) treatment followed by ST-R-R (T_5) (62654.13 kg/ha) on the basis of pooled data respectively, The highest net returns and B: C ratio of moongbeen crop of cropping system were found in ST-R-R (T_5) of Rs. 88,906.50 and 1:4.08, respectively. In potato crop of cropping system highest net returns and B:C ratio were found in Rs. 203973.00 and 1:1.94 in treatment of ST-ST-R (T_6) respectively. The net returns and B:C of maize of crop rotation were recorded Rs. 1,02,440.00 and 1:1.34 in the treatment of R-ST-R (T_3) respectively. Overall on the basis of pooled analysis in cropping system of moongbeen-potato-Maize with recommended NPK-NPK applied on soil test basis- Recommended NPK (R-ST-R) nutrient management were highest revised net return of Rs. 128058.50/ha in one calendar year, due to reason of higher production and productivity of potato in same treatment in central plain zone of Uttar Pradesh.

Key words- Potato, Green gram, Maize, Potato equivalent yield, Economics.

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Introduction:

Potato (*Solanum tuberosum* L.) is the most important non-cereal food crop of the world. It is third important crop after wheat and rice in terms of human consumptions. This is a carbohydrate-rich, but low fat food crops. Potatoes play an important role developing country, food security 50% of the world food energy needs or supplied by potatoes, rice, wheat and maize. Developing countries share



of global potato output now surpasses that of developed countries. Global potato consumption was on average 35kg/capita/year (**Anonymous, 2022**) Potato contents at least twelve essential vitamins and minerals and is a source of vitamin c, thiamine, iron and folic acid. Potato plants require relatively large amount of N for optimum growth and tuber production. Ideally, the fertilizer requirements should meet the difference between plant need and the N contribution from the soil. However, accurate prediction of soil N contributions is difficult because it varies considerably with soil type and environmental conditions which are beyond the control of growers. A more environmentally sound and cost effective strategy to improve N used efficiency would be to apply moderate amount of N at planting and were remainder as side dressings, as needed, before the last cultivation. Green gram-potato-maize cropping system as an important system and are being practiced to generate income and produces more food per unit of land to meet the rapidly growing population. Nutrient management on cropping system basis is more efficient and judicious than sole crop basis, because the residual effects of fertilizer applied to one crop are exploited by the succeeding crop. (**Singh and Kushwah, 2006**). Moongbean is used as intercrop with maize is one of the most important leguminous crops and has unique ability of biological N fixation, deep root system, mobilization of insoluble soil nutrient and bringing qualitative changes in the soil. Several studies have been conducted and recommendations have been made for fertilizer requirement of individual crop, but fertilizer recommendation for intercropping system are very much limited as it depends upon population and yield potential of the components crop in cropping based systems. Fertilizers in legume crops are important at initial stages. Nutrients in soil solutions are replenished either by desorption from soil surface, mineralization of soil organic matter or by addition of fertilizers. Fertilizer application is one of major production input recognized any crop-production system (**Rana et al., 2001**). Considering the above facts an experiment was conducted in maize to judge the effect of nutrients application on the potato based cropping system. Therefore, the present experiment was under taken to assess the effect of nutrient management in potato based most popular cropping system on production, potential and economics of potato crops.

Material and Methods

The present investigations during *Rabi* 2019-20 and 2020-21 at Vegetable Research Farm, Chandra Shekhar Azad University of Agriculture & Technology Kanpur. The experimental soil was sandy loam, neutral reaction of pH 7.5, low in organic C of 0.45% and available N of 225 Kg/ha, medium in available P of 12 kg/ha and available K of 155 kg/ha. The experiment was laid out Randomized Block Design (RBD) with three replications. Planting pattern were assigned to above plot fertility levels. In one calendar year was grown as main crops three cropping system viz; Moong bean – Potato - Maize. Potato is the main crop in this cropping system. The applied of recommended dose of fertilizers 180:80:100 NPK/ha, respectively. Moong bean open pollinated variety Azad Moong-1 (KM-2342), Maize in hybrid variety DEKALB-9108 and potato variety *Kufri* Bahar were used in this experiment. The main crop potato at spacing row to row 60 cm and plant to plant 20 cm with manually. Four potato rows and sixteen tubers in each rows except border rows were calculated at 90 days or full maturity. Equivalent yield of potato based system was calculated in terms of potato equivalent yield (PEY) by using prescribe formula. This research paper has been presented after doing a pooled analysis of the field trial data of two years (2019-20 and 2020-21). Other management practices were adopted as per recommendation of the potato crop cultivation.

Result and Discussion:

The effect of various cropping system in respect to plant height, number of leaves/plant and number of shoots/plant were found significant during the both years and pooled analysis. Number of leaves



per plant (12.80), number of shoots per plant (4.40) and plant height 69.1 cm on the basis of pooled data under treatment of R-ST-R (T₃). The total yield of potato was statistically higher of 35.94 t/ha in ST-ST-R cropping system (T₆) and equal in R-ST-R (T₃) 35.3t/ha. It may be due to supply of efficient and balanced amount of nutrients at different stage and increasing the availability to nutrient to the plant. The similar result was found by **Bindra and Thakur, 2005**.

Table.: Pooled analyzed data on Plant height, number of leafs and Number of shoots of potato during 2019-20 and 2020-21

Treatment	Plant height (cm)	No. of leaves/plant	No. of shoots/plant
R-R-R	58.80	9.64	3.20
R-R-ST	56.40	8.70	3.60
R-ST-R	69.10	12.80	4.40
R-ST-ST	60.98	10.65	3.05
ST-R-R	67.80	11.23	2.40
ST-ST-R	64.20	10.90	2.80
ST-R-ST	63.20	11.45	2.20
ST-ST-ST	59.70	10.30	2.60

Table.: Pooled analysed on basis total yield, tuber dry matter, haulm yield, biomass and harvest index of potato and system equivalent during 2019-20 and 2020-21.

Treatment	Haulm yield on dry basis (kg./ha)	Tuber yield on dry weight basis (Kg/ha)	Total Yield (t/ha)	Biomass yield on dry basis (kg/ha.)	Harvest index (%)	System equivalent yield (kg/ha)
R-R-R	299.46	8459.146	35.31	10465.53	80.82	61484.19
R-R-ST	273.42	7791.613	34.06	9541.501	81.66	60899.36
R-ST-R	234.36	7939.644	35.31	9181.752	86.47	62947.67
R-ST-ST	325.5	8175.258	34.5	10421.21	78.44	60754.65
ST-R-R	299.46	8011.112	35.7	10047.44	79.73	62654.13
ST-ST-R	338.52	9077.817	35.94	11650.57	77.91	61225.28
ST-R-ST	234.36	6920.618	32.71	8303.342	83.34	58705.64
ST-ST-ST	273.42	8161.293	34.46	9883.839	82.57	60210.64



Table-3: Pooled analysed data on economics of Moong bean under most popular cropping system during 2019-20 and 2020-21.

Treatment	Yield (t/ha)	Cost of cultivation (Rs./ha)	Gross income (Rs/ha)	Net returns (Rs/ha)	B:C
R-R-R	1.88	22273	108100	85827	1:3.85
R-R-ST	1.91	22273	109537.5	87264.5	1:3.91
R-ST-R	1.84	22273	105512.5	83239.5	1:3.73
R-ST-ST	1.8	22273	103500	81227	1:3.64
ST-R-R	1.93	21781	110687.5	88906.5	1:4.08
ST-ST-R	1.61	21483	92575	71092	1:3.30
ST-R-ST	1.75	21582	100625	79043	1:3.66
ST-ST-ST	1.73	21286	99475	78189	1:3.67

Table-4: Pooled analyzed data on economics of Potato under most Popular cropping system during 2019-20 and 2020-21.

Treatment	Yield (t/ha)	Cost of cultivation (Rs./ha)	Gross income (Rs/ha)	Net returns (Rs/ha)	B:C
R-R-R	35.31	105022	303666	198644	1:1.89
R-R-ST	34.06	105022	292916	187894	1:1.78
R-ST-R	35.31	105170	303666	198496	1:1.88
R-ST-ST	34.50	105170	296700	191530	1:1.82
ST-R-R	35.70	105022	307020	201998	1:1.92
ST-ST-R	35.94	105111	309084	203973	1:1.94
ST-R-ST	32.71	105022	281306	176284	1:1.67
ST-ST-ST	34.46	105022	296356	191334	1:1.82

Table-5: Pooled analysed data on economics of Maize under most popular cropping system during 2019-20 and 2020-21.

Treatment	Yield (t/ha)	Cost of cultivation (Rs./ha)	Gross income (Rs/ha)	Net returns (Rs/ha)	B:C
R-R-R	7.33	29720	117280	87560	1:2.94
R-R-ST	7.58	29230	121280	92050	1:3.14
R-ST-R	8.26	29720	132160	102440	1:3.44
R-ST-ST	7.66	29280	122560	93280	1:3.18
ST-R-R	7.57	29720	121120	91400	1:3.07
ST-ST-R	7.82	29720	125120	95400	1:3.20
ST-R-ST	7.70	29410	123200	93790	1:3.18
ST-ST-ST	7.64	29500	122240	92740	1:3.14



Applied crop rotation of (T3) treatment Moong bean-Potato-Maize was more produced system potato equivalent yield of 62947.67 kg/ha in the pooled basis analysis followed by treatment of ST-R-R (62654.13 kg/ha). Combination of different fertility levels had considerable effect on potato equivalent yield of system. Maximum potato equivalent yield on pooled basis was recorded recommended dose + next crop soil test basis + next crop recommended dose. However higher yield was observed in the system where maize in treatment R-ST-R and green gram in ST-R-R was including in succeeding. The lowest system productivity was obtained under green gram-potato-maize 58705.64 kg/ha in ST-R-ST. This result is also in conformity with the finding of Singh and Kushwah, 2006, Yadav et al. 2015, Kalpna et al. 2019 and Singh et al. 2013.

The determination of economic valuation of treatment was made under three important heads viz. gross income, net income and B:C ratio in invested. The all economic factor were estimated on per hectare area basis by considering the existing market values of different inputs and outputs which was depicted in Table. Most popular potato based cropping system Rs.3,84,175.50 in treatment R-ST-R on the pooled basis. The highest net returns and B: C ratio of moong bean crop was found in ST-R-R of Rs. 88,906.50 and 1:4.08, respectively. In potato crop highest net returns and B:C ratio were found in Rs. 2,03,973.00 and 1:1.94 in treatment ST-ST-R and in maize crop, net returns and B:C ratio were recorded Rs. 1,02,440.00 and 1:3.44 in the treatment R-ST-R. Therefore, over all most popular potato based cropping system along with R-ST-R nutrient was highly more received net profit of Rs. 1,28,058.50/ha over rest treatment under pooled analysis in present investigation. This finding also supported by Sarkar et al. (2011), Yadav et al. (2017) and Kalpana et al. (2019).

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