www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(7): 1360-1365

www.thepharmajournal.com
Received: 12-05-2021
Accepted: 21-06-2021

Nitesh Samadhiya
M.Sc. Student, School of Agriculture, ITM University, Gwalior, Madhya Pradesh, India

SP Singh
Principal Scientist, Department of Agronomy, ICAR-CPRI-RS, Gwalior, Madhya Pradesh, India

Girish Goyal
Assistant Professor, School of Agriculture, ITM University, Gwalior, Madhya Pradesh, India

Murlidhar J Sadawarti
Scientist (Sr. Scale), ICAR-CPRI-RS, Gwalior, Madhya Pradesh, India

SK Sharma
Senior Technical Officer, ICAR-CPRI-RS, Gwalior, Madhya Pradesh, India

LK Tripathi
Assistant Professor, School of Agriculture, ITM University, Gwalior, Madhya Pradesh, India

Corresponding Author:
Nitesh Samadhiya
M.Sc. Student, School of Agriculture, ITM University, Gwalior, Madhya Pradesh, India

Evaluation of organic and inorganic sources of nutrients in maize (*Zea mays* L.): Potato (*Solanum tuberosum* L.) cropping system

Nitesh Samadhiya, SP Singh, Girish Goyal, Murlidhar J Sadawarti, SK Sharma and LK Tripathi

Abstract
A field experiment was conducted to evaluate the "Effect of organic and inorganic sources of nutrients on maize-potato cropping system" during 2019-20 at ICAR-CPRI-RS, Gwalior M.P. The experiment consisted of five treatments with four replications. The results revealed that application of 100% RDF NPK gave higher number of cobs (1.88/plant) at 60 DAS and (2.33/plant) at harvest. Application of 100% RDF NPK recorded higher cob length (22.13 cm). In contrast, application of decomposed crop residue @ 25 t/ha + biofertilizer (*Azotobactor* @ 1000 ml/ha + *PSB* @ 1000 ml/ha) recorded higher test weight (1000 – grain weight) (372.3 g) as compare to other treatments. Application of 100% RDF NPK recorded highest number of grains/cob (254.50) and maximum grain yield (6.88 t/ha) and stover yield (7.28 t/ha) compared to other treatments. Application of 100% RDF NPK also recorded the highest total tuber number (653541/ha) and tuber yield (30.05 t/ha) compared to other treatments. The maximum gross returns (₹ 121088/ha) and net return in maize (₹ 95577.3/ha) was recorded with 100% RDF NPK. Maximum gross return (₹300500/ha) and net return (₹ 221399.5) were recorded in potato with 100% RDF NPK. The highest equivalent yield (6.88 t/ha) of maize crop was recorded with 100% RDF NPK. There was minimum 18.16% reduction under maize equivalent yield of maize-potato cropping system over 100% RDF NPK. Maximum equivalent yield (17.073 t/ha) of potato and maize equivalent yield of system (23.953 t/ha) was recorded with 100% RDF NPK which was significantly higher over other treatments. Maximum gross return (₹ 421588/ha) and net return (₹ 316976.8) of system were recorded with 100% RDF NPK. Application of (100% RDF NPK) gave the highest oc% (0.68), N content (212.36 kg/ha) and available K (409.46 kg /ha). Application of decomposed crop residue + bio fertilizers + FYM @ 7.5 t/ha recorded highest available P content in soil (20.77 kg/ha). Over all, application of 100% RDF NPK followed by decomposed crop residue @ 25 t/ha + biofertilizer (*Azotobactor* + PSB) + FYM@ 25 t/ha are better sources of nutrient application in maize-potato cropping system as compared to other treatments based on their economic viability.

Keywords: FYM, cropping system, equivalent yield, vermi-compost, potato, maize

Introduction
Maize- potato is an important emerging cropping system in India. There is potential for increasing its area in central India to replace Rice-potato, rice-wheat cropping system, which has resulted in resource degradation and unsustainable form of agriculture. With increase in nutrient deficiency particularly in soil and human being, it is now becoming important for taking care of soil nutrient hunger and malnutrition in human. The growth and development of plant is also greatly influenced by genotype, planting methods and nutrients availability. Among various inputs, mineral nutrition of plants is the key input, which makes maximum contribution to crop productivity. Nearly 55% of increase in food grain production during last two decades has come through increasing levels of fertilizer application. However, total annual removal of nutrient by crop and cropping system being much higher than the amount added through fertilizers, it has resulted in negative nutrient balance in the soil. Therefore, prompt effort is needed, not only to increase and stabilize the crop production but also to enhance the nutrient use efficiency which shows great influence on crop production. Maize (*Zea mays L*) is one of the most versatile crops having wider adaptability under varied agro-climatic conditions. In India, maize is the third most important food crop after rice and wheat. Maize (*Zea mays* L.) is one of the main sources for food, feed, forage and processed products. In India, it is grown on an area of 9.86 million hectares with the annual production of 26.26 million tonnes and productivity of 2664 kg/ha.

Currently, Madhya Pradesh contributes about 13.02 per cent in area and 12.06 per cent in production of maize in the country.

Potato (*Solanum tuberosum* L.) is a carbohydrate-rich, but low fat food crop contributes substantially towards food and nutritional security in the world. India ranks 2nd in production after China (FAO STAT, 2019) [5]. In India potato production is mainly confined to Uttar Pradesh, West Bengal, Bihar, Madhya Pradesh, Punjab, Assam, Gujarat and Haryana. In India, it is grown in an area of 2.179 million hectares with the production of 48.6 million tonnes. Cropping system refers to the crops and crop sequences and the management technique used on a particular field over years. Maize – Potato cropping system is an important system and is being practiced to generate income and produce 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) [15]. Since, both the crops are high nutrient demanding and deplete soil fertility extensively. Poor recycling of organic sources also leads to emergence of multiple nutrient deficiencies (Kumar, 2008) [6]. Hence, judicious nutrient management planning in a system perspective is the need which can be obtained with following organic and inorganic sources under maize-potato cropping system. Long-term studies in India indicated that application of all the needy nutrients through chemical fertilizers have deleterious effect on soil health leading to unsustainable yields (Anand Swarup, 2002) [1]. Therefore, there is a need to improve nutrient supply through organic and inorganic sources. Removal and unsustainable management of crop residues may be one of the major reasons for poor fertility status as well as productivity. The removed crop wastes are used mainly for cattle feed, domestic fuel and packaging. Surplus farm wastes are burnt which may contribute to the environmental pollution. Organic plant residues hold a great promise due to their local availability *vis-a-vis* their effect on physic-chemical properties and fertility of soil (Bellakki and Badanur, 1994) [2]. Long–term studies have also shown that on account of its sparse roots, nutrient need of potato is much higher than that of cereals, and the cereal crop succeeding potato can thrive well on the residual fertility (Singh and Kushwah, 2006) [14]. To increase the production and quality of both crops (maize and potato), judicious combination of organic sources of nutrients along with inorganic and bio - fertilizer (*Azotobactor*, *PSB*) needs to be found out.

Materials and Methods

The present experiment was carried out during 2019-2020 at ICAR-CPRI-RS, Gwalior M.P to judge the effect different nutrient management treatment combinations in maize potato cropping system**.** The experimental soil was silty – clay-loam in texture, with pH 6.89, EC 0.41 dS/m, Organic carbon 0.58%. The study involved five treatments *viz.* T_1: Control, T_2: 100% RDF NPK, T_3: decomposed crop residue @ 25 t/ha + bio -fertilizer (*Azotobactor* @ 1000 ml/ha + *PSB* @ 1000 ml/ha), T_4: decomposed crop residue @ 25 t/ha + biofertilizer (*Azotobactor* @ 1000 ml/ha + *PSB* @ 1000 ml/ha) + (FYM @ 25 t/ha), T_5: decomposed crop residue @ 25 t/ha + bio - fertilizer (*Azotobactor* @ 1000 ml/ha + *PSB* @ 1000 ml/ha) + (vermi - compost @ 7.5 t/ha) in R.B.D design with four replications. The recommended dose of N, P_2O_5 and K_2O were 120, 60 and 40 kg/ha and 180, 80 and 120 kg/ha for maize and potato, respectively. Nitrogen, Phosphorus and Potash were applied in the form of urea, dia-ammonium phosphate (DAP) and muriate of potash (MOP), respectively. Maize (*kharif*) and potato (*rabi*) seeds/tubers were sown/planted at spacing 60 cm × 20 cm, respectively. The gross area of plot was 4.4× 4.8 m^2 and net area 3.6 × 4.0 m^2. Hybrid variety VISHWAS-72 and Kufri Jyoti were used for experimentation in maize and potato, respectively. Cultural practices were followed as per standard recommendations for region to maize and potato. The various yield parameters were recorded at 30, 60 DAS and at harvesting in maize and at 30, 60 DAP and at 90 DAP in potato. Equivalent yield of maize - potato cropping sequence was calculated in terms of maize. Economics in the cropping system was calculated by taking MSP of maize Rs 17.60 kg/ha and potato@ Rs 10/kg during 2019.

Results and Discussion

Number of cobs

At 60 DAS, the higher number of cob (1.88 cob/plant) was registered with 100% RDF NPK followed by decomposed crop residue and biofertilizers+ FYM @ 25 t/ha. The lowest number of cobs/plant was recorded in control (1.30 cob/plant). At harvesting, the maximum number (2.33 cobs/ plant) was under 100% RDF NPK followed by decomposed crop residue + biofertilizers +FYM @ 25 t/ha) 2.01 cobs/plant.

Cob length (cm)

The effect of treatments with respect to average cob length was found significant. Higher cob length (22.13 cm) was recorded with100% RDF NPK followed by decomposed crop residue + biofertilizers + FYM @ 25 t/ha (21.27 cm). The lowest cob length (19.26 cm) was recorded with control.

Test weight (1000 – grain weight)

Application of decomposed crop residue @ 25 t/ha + *Azotobactor* + *PSB* recorded 372.3 g test weight followed by control (364.4 g). The application of 100% RDF NPK gave lowest test weight 338.9 g followed by vermi-compost which gave little higher 340.3 g.

Number of grains/cob

Application of 100% RDF NPK gave the highest number of grains per cob (254.50) followed decomposed crop residue and biofertilizers + FYM @ 25 t/ha) 241.75. The number of grains in decomposed crop residue + bifertilizer (*Azotobactor* and *PSB*) was 237. The lowest number of grains per cob (200.75) was noticed in control.

Yield

Grain yield (t/ha)

Application of 100% RDF NPK recorded maximum grain yield (6.88 t/ha) and was significantly superior over rest of the treatments. Decomposed crop residue and biofertilizers + FYM @ 25 t/ha) was followed by 100% RDF NPK which recorded (5.21 t/ha). Decomposed crop residue and biofertilizers + vermicompost @ 7.5 t/ha recorded 5.02 t/ha and was followed by decomposed crop residue and biofertilizers (*Azotobactor* 1000 ml + *PSB* 1000 ml). The lowest grain yield 4.50 t/ha was recorded with control. This may be due to higher cob number/plant, average cob length, test weight (1000 grain weight), number of grains per cob and grain weight/cob under this treatment. Due to quick

availability of nutrient in soil 100% RDF NPK recorded significantly higher stover weight over other treatments. Shilpashree *et al.,* (2012) [12] noticed significantly higher cob length (18.32 cm), cob girth (18.25 cm) and 100 seed weight (37.87g) under the application of 100% N + 7.5 t/ha of FYM except for the test weight which was on par with treatment receiving 150% recommended N through fertilizer and FYM.

Stover yield (t/ha)

Maximum stover yield (7.28 t/ha) was recorded with 100% RDF NPK, followed by with decomposed crop residue and biofertilizers + FYM @ 25 t/ha (5.96 t/ha). Decomposed crop residue + biofertilizers+ vermicompost @ 7.5 t/ha recorded 5.50 t/ha stover yield followed by decomposed crop residue + biofertilizers + FYM @ 25 t/ha. The lowest stover yield (4.67 t/ha) was recorded in control. This may be due to increased growth parameters because of increased supply of all essential plant nutrient as well as increased physio-chemical and biological properties of soil. All favourable situation might have resulted in greater accumulation of carbohydrates and their translocation from sources to the sink owing to higher availability and uptake of K nutrient which, in-turn, increased the higher number of grains/cob and grain weight/cob. K nutrient have direct impact on translocation of photosynthates from source to sink Cakmak *et al.,* (1994) [3]. It is further mentioned that the improvement in yield attributes might have resulted from favourable influence of different treatments of nutrient application on growth attributes and greater partitioning of metabolites and adequate translocation of photosynthates and nutrients to developing reproductive structures. Thus result is supported by Kumar *et al.,* (2017) [8], Mahesh *et al.,* (2010), Pavithra *et al.,* (2018) [9], Prajapati *et al.,* (2018) [10], Singh *et al.,* (2017) [13].

Economics of treatments

₹20000 and ₹20500 was the common cost of cultivation for organic and inorganic treatments, respectively. However, the total cost of cultivation varied from treatment to treatment and it ranged from ₹20500 to ₹37250.82.Whereas, the minimum cost of cultivation was ₹20500 in control. The maximum total cost of cultivation ₹37250.82 was recorded in treatment decomposed crop residue + biofertilizers + vermicompost @ 7.5 t/ha). The maximum gross returns (₹121088/ha) was recorded with 100% RDF NPK. This treatment was superior to other treatments. The minimum gross return (₹79200) was recorded in control. The maximum net return (₹95577.3) was recorded with 100% RDF NPK. The minimum net return (₹51101.18) was recorded with decomposed crop residue +biofertilizers+ vermicompost @ 7.5 t/ha. Chaudhary *et al.,* (2017) [4] recorded the higher net return of ₹51101/ha and B: C ratio value of 2.57 with 100% RDF.

Yield attributes of potato

Tuber number/plant at harvest

The effect of various treatments with respect to tuber number of potato was found significant at 90 DAP. Total number of tuber per plant was highest (14.81/plant) with decomposed crop residue @ 25 t/ha + *Azotobactor* @ 1000 ml/ha and *PSB* @ 1000 ml/ha followed by control (14.62/plant). The lowest number of tuber per plant at harvest was recorded 12.68/plant with decomposed crop residue + biofertilizers + vermicompost @ 7.5 t/ha, followed by 13.75/plant in treatment decomposed crop residue + biofertilizers + FYM @ 25 t/ha

Number of tubers/ha

Highest small tubers (< 25g) was recorded with control (280625/ha) followed by (279166.66/ha) with the application of 100% RDF NPK. The lowest number of small tubers was recorded in treatment decomposed crop residue + biofertilizers + vermicompost @ 7.5 t/ha 183333.33/ha. 25-50 g medium size grade tuber number was highest with the application of 100% RDF NPK (178541.66/ha), followed by control (159583.33/ha). The minimum number of tuber (139375/ha) was recorded with decomposed crop residue + biofertilizers + vermicompost @ 7.5 t/ha. Application of 100% RDF NPK (107083.33/ha) gave the maximum number of medium size 50 – 75 g grade tubers compared to other treatments, followed by 100833.33/ha in decomposed crop residue @ 25 t/ha + bio fertilizer + *Azotobactor* @ 1000 ml/ha + *PSB* @ 1000 ml/ha. The minimum number of tubers 68125/ha under this category was recorded with decomposed crop residue + biofertilizers + vermicompost @ 7.5 t/ha followed by 73750/ha in control. Maximum number of large size tubers (> 75 g) was obtained in 100% RDF NPK (88750/ha) followed by (79375/ha) decomposed crop residue @ 25 t/ha + bio fertilizer + *Azotobactor* @ 1000 ml/ha + *PSB* @ 1000 ml/ha. The minimum number of tuber 50208.33/ha were recorded with control followed by 60000/ha in decomposed crop residue + biofertilizers + FYM @ 25 t/ha. This may be due to higher availability of nutrient under 100% RDF NPK. Sood (2007) also reported corroboratory findings in potato crop. Kumar *et al.,* (2013) [9] reported that nutrient supply through only organic sources are not adequate for a quick growing high fertilizer responsive crop like potato.

Yield of tubers (t/ha).

Application of 100% RDF NPK gave the highest small size (<25g) tuber yield (3.40t/ha) as compared to other treatments which was significantly higher over all other treatments followed by 3.19 t/ha in control. The minimum tuber yield 92.54 t/ha) of small size tubers was recorded in decomposed crop residue + biofertilizers + vermicompost @ 7.5 t/ha. 25-50 g medium size tubers yield was highest with 100% RDF NPK (6.72t/ha) which was significantly higher over all other treatments. It was followed by control (5.40t/ha). The minimum yield under this tuber size was recorded in decomposed crop residue + biofertilizers + vermicompost @ 7.5 t/ha (5.006 t/ha).

50-75 g medium size tubers yield was with 100% RDF NPK (7.66 t/ha) which was significantly higher over all other treatments and was followed by decomposed crop residue + biofertilizers + FYM @ 25 t/ha (7.34 t/ha). The minimum tuber yield under this category of tuber size was recorded in control (4.45t/ha).

The highest tuber yield under the large size tubers (>75 g) 12.27 t/ha was recorded with 100% RDF NPK which was significantly higher over all other treatments and was followed decomposed crop residue + biofertilizers + FYM @ 25 t/ha) 9.61 t/ha. The minimum yield of tuber under this category was recorded in control 5.64t/ha. Ram *et al.,* (2017) [11] reported that significantly higher No. of stem (7.10 / plant) and total yield of tuber (225.26 q/ha) under the application of recommended dose of NPK (150: 100: 120 kg/ha) package of practices. However, the maximum dry matter content of tubers (19.66%) was recorded under residue incorporation + biofertilizer (*Azotobactor* + *PSB*) + vermicompost @ 5 t/ha + microbial culture to decomposed residue and minimum dry weight of tubers (18.46%), No. of stem (4.20/plant) and total

yield of tuber (122.89 q/ha) were under application of crop residue incorporation.

Economics of treatments

₹69500 and ₹70200 was the common cost of cultivation in organic and inorganic treatments, respectively. However, the total cost of cultivation was varied from treatment to treatment and it was ranged from ₹69500 to ₹88520.20, respectively. Whereas the minimum cost of cultivation was ₹69500 in control. The maximum total cost of cultivation ₹88520.20 was recorded in decomposed crop residue + biofertilizers + vermicompost @ 7.5 t/ha. Different nutrient application treatments gave more gross returns (₹/ha) than control treatment. The maximum gross returns (₹300500/ha) was recorded in 100% RDF NPK. This treatment was superior to other treatments, respectively. The minimum gross return ₹187100 was recorded in control. It was due to higher tuber yield in 100% RDF NPK treatment and lowest under control. The maximum net returns ₹221399.5 was in 100% RDF NPK. The minimum net return ₹117600 was recorded in control. Contrary to these findings Singh *et al.*, (2011) [14] revealed that higher economics parameters *viz*. Benefit- cost ratio (1.57), net returns (₹36713/ha), return per ₹spent (0.57), production efficiency (kg/ha/day) with 5t FYM/ha + 50% RDF compared with 100% RDF in black gram-potato-wheat sequence. Singh and Lal (2011) [11] recorded that highest net return, B: C ratio, production efficiency, monetary return efficiency and sustainable yield index under the application of FYM @ 10 t/ha to potato crop.

Equivalent yield of system

Equivalent yield of yield of maize

Equivalent yield of maize was calculated in which highest equivalent yield was (6.88 t/ha) recorded with 100% RDF NPK. The lowest equivalent yield of maize was (4.50 t/ha) recorded with control.

Equivalent yield of potato

Highest equivalent yield was (17.073 t/ha) recorded with 100% RDF NPK and lowest recorded with control (10.630/ha). Contrary to it, highest maize equivalent yield (23.937 t/ha) of cropping system was recorded with 100% RDF NPK which was significantly higher over other treatments, it was followed by decomposed crop residue + biofertilizers + 25 t FYM/ha. Higher equivalent yield in above treatments were due to higher yield in above treatments under organic system there was 18.16% minimum reduction in maize equivalent yield of system over RDF NPK. Singh *et al.*, (2011) [11] also adopted higher economics parameters *viz.* Benefit- cost ratio (1.57), net returns (₹36713/ha), return per ₹spent (0.57), production efficiency (kg/ha/day) with 5t FYM/ha + 50% RDF compared with 100% RDF in black gram-potato-wheat sequence. Singh and Lal (2011) [11] recorded that highest net return, B: C ratio, production efficiency, monetary return efficiency and sustainable yield index under the application of FYM @ 10 t/ha to potato crop.

Economics of system

Cost of cultivation (₹/ha)

The total cost of cultivation varied from treatment to treatment and it was ranged from ₹90000 to ₹125771.02, respectively. Whereas the minimum cost of cultivation was ₹90000 in control. The maximum total cost of cultivation ₹125771.02 was recorded with decomposed crop residue + biofertilizers + vermicompost @ 7.5 t/ha due to higher cost of vermi-compost.

Gross return (₹/ha)

Data embodied in the table resulted that different nutrient application treatment which gave more gross return (₹/ha) than control. The maximum gross return (₹421588/ha) was recorded with 100% RDF NPK. This treatment was superior to other treatments. The minimum gross return ₹266300 was recorded in control.

Net returns (₹/ha)

The maximum net returns ₹316976.8 was in 100% RDF NPK. The minimum net return ₹176300 was recorded in control. Organic manures solely not sufficient for achieving higher growth and yield compared to 100% RDF NPK. From the farmer point of view, economics is the main concern. Application of 100% RDF NPK gave maximum net return/ha, followed by decomposed crop residue @ 25 t/ha + biofertilizer (*Azotobactor* + *PSB*) + FYM@ 25 t/ha both in maize and potato crop.

Fertility status of soil

Application of decomposed crop residue @ 20 t/ha + FYM @ 25 t/ha gave the highest OC (0.68%) which was followed by decomposed crop residue + bio fertilizers + vermi-compost @ 7.5 t/ha (0.66% OC). The lowest OC (0.47%) was recorded in control. Application of 100% RDF NPK gave the highest N content (212.36 kg/ha) which was significantly higher than other treatments. It was followed by decomposed crop residue + bio fertilizers + vermicompost @ 7.5 t/ha (209.36 kg/ha). The lowest available N content (180.90 kg/ha) was recorded with control. Application of decomposed crop residue + bio fertilizers + FYM @ 7.5 t/ha gave the highest available P content in soil (20.77 kg/ha), which was followed by 100% RDF NPK (19.89 kg/ha). The lowest P content (12.24 kg/ha) was recorded in control. Application of 100% RDF NPK recorded highest available K content (409.46 kg /ha) which was significantly higher than other treatments. It was followed by decomposed crop residue + bio fertilizers + FYM @ 25 t/ha) with (405.81 kg K/ha). The lowest K content (303.73 kg K/ha) was recorded in control. Over all, application of 100% RDF NPK followed by decomposed crop residue @ 25 t/ha + bio-fertilizer (*Azotobactor* + *PSB*) + FYM@ 25 t/ha are better sources of nutrient application in maize-potato cropping system as compared to other treatments.

Table 1: Effect of organic and inorganic sources of nutrients on yield attributes and yield of maize in maize-potato cropping system

Treatments	Cob number/Plant			Average length of a cob	No. of Grains/cob	1000-Grain weight g	Grain yield(t/ha)	Stover yield(t/ha)	Economics of maize			
	30 DAS	60 DAS	Harvesting						Total cost of cultivation(₹/ha)	Gross return(₹/ha)	Net returns ₹/ha	B:C ratio
T_1	0	1.30	1.49	19.26	200.75	364.4	4.50	4.67	20500	79200	58700	2.86
T_2	0	1.88	2.33	22.13	254.50	338.9	6.88	7.28	25510.70	121088	95577.3	3.74
T_3	0	1.36	1.68	19.96	237	372.3	4.71	4.86	22620.50	82896	60275.5	2.66
T_4	0	1.53	2.01	21.27	241.75	363	5.21	5.96	27588.25	91696	64107.75	2.32
T_5	0	1.46	1.75	20.62	230.75	340.3	5.02	5.50	37250.82	88352	51101.18	1.37

S.E(m) ±	0	0.056	0.175	0.535	1.167	2.349	0.019	0.061				
C.D (at 5%)	0	0.176	0.544	1.665	3.637	7.31	0.059	0.02				

T_1: Control, T_2: 100% RDF NPK, T_3: Decomposed crop residue @ 25 t/ha + biofertilizer (*Azotobacter @ 1000 ml/ha + PSB @ 1000 ml/ha*), T_4: Decomposed crop residue @ 25 t/ha + biofertilizer (*Azotobacter @ 1000 ml/ha + PSB @ 1000 ml/ha*) + FYM @ 25 t/ha, T_5: Decomposed crop residue @ 25 t/ha + biofertilizer (*Azotobacter @ 1000 ml/ha + PSB @ 1000 ml/ha*) + VC @ 7.5 t/ha, VC = vermi-compost, RDF NPK = Recommended dose of N, P_2O_5 and K_2O

Table 2: Effect of organic and inorganic sources of nutrients on number of tubers of potato and number of tuber/plant of potato at harvesting in maize-potato cropping system

Treatments	Number of tuber/ha					Yield of tuber (t/ha)				
	Small size (< 25g)	Medium size (25-50g)	Medium size tubers (50-75g)	Large size (> 75g)	Total (all grades)	Small size (<25g)	Medium size (25-50g)	Medium size (50-75g)	Large size (>75g)	Total (all grades)
T_1	280625	159583.33	73750	50208.33	564166.66	3.19	5.40	4.45	5.64	18.71
T_2	279166.66	178541.66	107083.33	88750	653541.65	3.40	6.72	7.66	12.27	30.05
T_3	224166.66	143541.66	100833.33	79375	323749.99	2.72	5.066	6.41	9.14	20.11
T_4	252708.33	152916.66	100625	60000	566249.99	3.05	5.33	7.34	9.61	25.33
T_5	18333.33	139375	68125	71458.33	462291.66	2.54	5.006	4.93	7.64	23.33
S.E(m) ±	823.529	597.220	619.539	272.030	N.S	0.151	0.12	0.14	0.151	0.407
C.D (at 5%)	2565.650	1860.599	1930.133	847.492	N.S	0.47	0.38	0.43	0.48	1.269

Table 3: Effect of organic and inorganic sources of nutrients on economics of potato and cropping system and equivalent yields in maize-potato cropping system

Treatments	Economics of potato				Economics of system				Equivalent yield (t/ha)		
	Cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	B: C ratio	Cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	B: C ratio	Maize	Potato	Sequence
T_1	69500	187100	117600	1.69	90000	266300	176300	1.95	4.50	10.630	15.13
T_2	79100.50	300500	221399.5	3.01	104611.2	421588	316976.8	3.29	6.88	17.073	23.953
T_3	73485.20	201100	127614.8	1.73	96105.7	283996	187890.3	1.95	4.71	11.426	16.136
T_4	78520.20	253300	174799.8	2.22	106108.45	344996	238887.55	2.25	5.21	14.392	19.602
T_5	88520.20	233300	144779.8	1.63	125771.02	321652	195880.98	1.55	5.02	13.255	18.275
S.E(m) ±									0.118	0.95	0.662
C.D (at 5%)									N.S	2.98	2.063

PSB = phosphate solubilizing bacteria

Table 4: Effect of organic and inorganic sources of nutrients on fertility status of soil under maize-potato cropping system

Treatments	Available nutrients in soil (Kg/ha)			
	N	P	K	OC (%)
T_1	180.90	12.24	303.73	0.47
T_2	212.36	19.89	409.46	0.50
T_3	185.39	18.32	362.67	0.55
T_4	194.01	20.77	405.81	0.68
T_5	209.36	18.56	388.55	0.66
S.E(m) ±	4.04	0.371	1.143	0.027
C.D (at 5%)	12.59	1.157	3.561	0.084

OC= organic carbon

References

1. Anand Swarup. Lessons from long term fertilizer experiments in improving fertilizer use efficiency and crop yields. Fertilizer news 2002;47(2):59-66.
2. Bellakki MA, Badanur VP. Effect of crop residue incorporation on physical and chemical properties of a vertisols and a yield of sorghum. Journal of Indian society of Soil Sciences 1994;42(4):535-53.
3. Cakmak I, Hengeler C, Marschner H. Partitioning of shoot and root dry matter and carbohydrates in bean plants suffering from phosphorus, potassium and magnesium deficiency. Journal of Experimental Botany 1994;45(9):1245-1250.
4. Chaudhari CR, Patel PM, Dabhi MS, Patel VP. Response of organic acids and inorganic fertilizers on growth, yield and quality of *Rabi* maize (*Zea mays* L.). International Journal of Chemical Studies 2017;5(4):964-966.
5. FAO (Food and Agriculture organization). Barried treasure: The potato (*http://*www.fao.org) 2019.
6. Kumar A. Direct and residual effect of nutrient management in maize (*Zea mays*) – wheat (*Triticum aestivum*) cropping system. Indian Journal of Agronomy 2008;53(1):37-41.
7. Kumar M, Baishaya LK, Ghosh DC, Ghosh M, Gupta VK, Verma MR. Effect of organic manures, chemical fertilizers and biofertilizers on growth and productivity of rainfed potato in the eastern Himalayas. Journal of Plant Nutrition 2013;36:1065-1082.
8. Kumar P, Kumar A, Kumar N, Ahamad A, Verma MK. Effect of Integrated Nutrient Management on Productivity and Nutrients Availability of Potato. International Journal of Current Microbiol Application Science 2017;6(3):1429-1436.
9. Pavithra M, Reddy GP, Chandrika V, Umamahesh V. Nitrogen and Sulphur nutrition for enhancing the growth and yield of quality protein maize (QPM). Journal of Pharmacognosy and Phytochemistry 2018;7(6):142-144.
10. Prajapati VK, Swaroop D, Masih NA, Lakra R. Effect of different dose of NPK and vermicompost on growth and yield attributes of maize [*Zea mays* (L.)] Cv. MM2255. Journal of Pharmacognosy Phytochemistry 2018;7(1):2830-2832.
11. Ram B, Singh BN, Kumar H. Impact of various organic treatments on growth, yield and quality parameters of potato. International journal of pure and applied bioscience 2017;5(3):643-647.
12. Shilpashree VM, Chindanandappa HM, Jayaprakash R, Punitha BC. Influence of integrated nutrient management

practices on productivity of maize crop. Indian Journal of Fundamental and Applied Life Sciences 2012;2(1):45-50
13. Singh G, Singh A, Kaur G, Jatana MMS, Rani S. Effect of Integrated Nutrient Management on Growth and Yield Attributes of Potato (*Solanum tuberosum* L.) International Journal of Current Microbiology and Applied Sciences 2018;7(6):2051-2056.
14. Singh SK, Lal SS. Integrated nutrient management in potato based cropping systems in south Bhihar alluvial plains. Potato Journal 2011;38(2):162-169.
15. Singh SP, Kushwah VS. Effect of integrated use of organic and inorganic sources of nutrient on potato production. Indian Journal of Agronomy 2006;51:236-38.