International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(6): 1336-1342

Received: 06-09-2017
Accepted: 07-10-2017

BS Gunjal
Department of Agronomy, Mahatma Phule Krishi Vidyapeeth, Rahuri Dist. Ahmednagar, Maharashtra State, India

SS Chitodkar
Department of Agronomy, Mahatma Phule Krishi Vidyapeeth, Rahuri Dist. Ahmednagar, Maharashtra State, India

Correspondence
BS Gunjal
Department of Agronomy, Mahatma Phule Krishi Vidyapeeth, Rahuri Dist. Ahmednagar, Maharashtra State, India

Direct and residual fertility of varying sources and levels of nutrients on growth and yield behaviour of sweet corn (*Zea mays ver.* L.) – potato (*Solanum tuberosum* L.) cropping system

BS Gunjal and SS Chitodkar

Abstract
An experiment entitled "Effect of integrated nutrient management in sweet corn-potato cropping sequence" was conducted during *kharif* and *rabi* season of 2014 to 2015 at Instructional Research Farm, Central Campus, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri. Results revealed that the application of the INM treatments, the various fertilizer levels to preceding sweet corn crop significantly influenced T_7 - 125% RDN + 25% N through VC was found superior in growth attributes of sweet corn *viz.*, plant height, number of leaves plant^{-1}, leaf area and dry matter plant^{-1} at all crop growth stages of sweet corn during both the years of *kharif* season. The treatment T_7- 125% RDN + 25% N through VC recorded significantly higher values of all yield contributing characters of sweet corn *viz.*, length of cob with husk, girth of cob with husk, length of cob without husk, girth of cob without husk, weight of cob plant^{-1}, weight of cob without husk cob^{-1}, weight of husk, weight of grains cob^{-1}, number of grain lines cob^{-1}, number of grain lines^{-1}, number of grains cob^{-1}, weight of shelled cob during both the years of investigation. The maximum and significantly higher green cob yield, green fodder yield, biological yield and harvest index of sweet corn was observed in treatment T_7 – 125% RDN + 25% N through VC.
On the residual fertility of FYM (100% GRDF) potato plant recorded the highest plant height, LAI, number of haulms and DMA in haulms. Among the INM treatments, the various fertilizer levels to preceding sweet corn crop significantly influenced T_1 - 100% GRDF was found superior in growth attributes of potato *viz.*, plant height, number of leaves plant^{-1}, leaf area and dry matter plant^{-1} at all crop growth stages of potato during both the years of experimentation. The various fertilizer levels to preceding sweet corn crop significantly influenced T_1 - 100% GRDF was found superior in yield attributes of potato *viz.*, medium tubers, big tubers, total tubers, weight of tubers per plant. The various fertilizer levels to preceding sweet corn crop significantly influenced T_1 - 100% GRDF was found superior in tuber yield (280.21 and 286.96 q ha^{-1}) and haulm yield (12.31and 13.52 q ha^{-1}) during both the years of *rabi* season experimentation.

Keywords: Farmyard manure, Growth parameters, Sweet corn, vermi compost, Yield, Yield attributes

1. Introduction

Maize is one of the important cereal crops both as food for human being and feed for animals in the world's agricultural economy. Over last decade it is the only cereal, which has registered positive growth rate in terms of production and productivity and presently it has8.94% growth in production (DMR, 2030) [7]. It is considered as one of the potential driver for crop diversification under different situation. In India maize is consumed in various forms. Sweet corn is one of the major one and is prominently used in preparation of snacks in different parts of the world. A short duration cash crop like potato (*Solanum tuberosum* L.), which is highly amenable to adjustment, fits well in various cropping systems. It contributes to world food basket just after rice, wheat and maize. It has higher nutritive value with 20.6% carbohydrates, 2.1% protein, 0.3% fat, 1.1% crude fibre and 0.9% ash. It also contains goodamount of amino acids like *leucine*, *tryptophane* and *isolucine* (Khurana and Naik 2003) [12]. Potato can be fitted suitably into different cropping system to increase the efficiency of timeand resources (Sharma *et al*., 2006) [24]. Maize–potato cropping system has the potential to become a successful cropping system in northern plains zone and central zone of India. Studies have shown that potato based cropping systems are usually more profitable than cereal–based cropping systems

(Pandey *et al.*, 2008) [20]. There is increasing pressure on natural resources like decline water table, nutrient imbalance, changing disease and pest scenario in the country, which is ultimately lead to decline in crop productivity and emerging agro–ecological problems. In this condition, maize is the only crop to overcome this pressure due to itsexuberant ability to growth. Maize based cropping system are emerging an alternative optionfor crop diversification. By adopting this system we can ensure food and nutritional security byutilizing declining land and water resources. By this way we can generate income andemployment for resource poor farmers (FAO, 2000) [9]. Both maize and potato are nutrientexhaustive crops and respond well to the higher levels of fertilizers. A crop of maize yielding about 14 t ha^{-1} of dry matter takes up about 161, 34 and 110 kg ha^{-1} NPK, respectively. Similarly, a good crop of potato yielding about 40 tonnes removes 170–180, 25 and 250 kg ha^{-1} NPK, respectively (FAI, 2010) [8]. The application of heavy doses of chemical fertilizers enhanced the productivity of these crops on one ends but at another end continuous application of chemical fertilizers deteriorates soil health, leading to declining productivity of the soil. The application of scientific approaches of organic farming is an alternative and holistic way for sustainable agriculture production. It mainly focuses on the soil health by largely excluding the use of chemicals and including organic manures. It promotes biodiversity and biological activity in the soil. It has potential to improve the content of different essential micronutrients, both in soil as well in grain produce. Besides production of high quality products, it conserves the natural resources, soil fertile, and biodiversity in rich. Organic farming has potential for reducing some of the negative impact of the conventional agriculture in context to environment and provides avenues to the productivity of degraded soils (Ghosh *et al*., 2007). Kumar *et al*. (2005) [15] recorded prolonged effect of organic manures on soil fertility and soil moisture balance. Therefore, the present study was planned to evaluate the effect of different levels of organic sources of nutrients on growth, yield and yield attributes of sweet corn – potato cropping system.

Materials and Methods

Site Description

A field experiment was conducted from 2014 to 2015 at the Post Graduate Institute Research Farm, of Mahatma Phule Krishi Vidyapeeth, Rahuri is lies between 19^0 48'N and 19^0 57'N Latitude and 74^0 32'E and 74^0 19'E longitude. The altitude varies from 495 to 569 meters above mean sea level. This tract is lying on the Eastern side of Western Ghat and falls under rain shadow area. Climatologically, it falls in semi arid tropics with an annual rainfall varying from 307 to 619 mm. The average annual precipitation is 520 mm. Out of the total annual rainfall, about 80 per cent rains are received from South – West monsoon (June to September), while rest receives from North – East monsoon. The number of rainy days varies from 15-45 in a year. The mean annual maximum and minimum temperature ranges from 33 ^{0}C to 43 ^{0}C and 3 ^{0}C to 18 ^{0}C, respectively. The mean relative humidity during morning and evening hours is 59 and 35 per cent, respectively. The mean pan evaporation ranges from 5.3 to 12.1 mm and the sunshine hours ranges from 7 to 9 day^{-1}.

Experimental design and treatments

The experiment included two crops per year, namely, *kharif*-sweet corn (July-November), winter potato (November-March).The field trial was conducted on the same field and on same layout without changing randomization during both the years. The experiment was laid out in Randomized Block Design, during *kharif* season the main plot treatments comprised of the gross recommended dose of fertilizers and three levels of FYM and vermi compost to sweet corn, replicated thrice and during *rabi* season each sub plot treatment was divided into two sub plot treatments with two levels of the gross recommended dose of fertilizers to potato. Thus, during *rabi* season there were fourteen treatments comprised of seven main plot treatment of FYM and vermi compost and two sub plot treatments comprised of two levels of fertilizer to potato replicated thrice in split plot design. The treatment details along with symbols used are presented in following Table 1.The treatment consisted T_1 – 100% GRDF, T_2 - 75% RDN + 25% N through FYM, T_3 - 75% RDN + 25% N through VC, T_4 – 100% RDN + 25% N through FYM T_5 - 100% RDN + 25% N through VC, T_6 – 125% RDN + 25% N through FYM and T_7 – 125% RDN + 25% N through VC for *kharif* sweet corn as a main plot treatment, whereas for *rabi* potato two sub plot treatment levels of GRDF viz., F_1 - 75% GRDF and F_2 - 100% GRDF replicated two times in split plot design resulting in seven treatment combinations replicated thrice during *kharif* season and fourteen treatment combinations during *rabi* season in RBD-split plot design replicated thrice. The experiment was conducted on same site without changing the randomization of the treatments for successive years. In doing so the respective contribution of P and K from vermi compost and FYM was also considered. The fertilizers used were urea for N, single superphosphate for P, and muriate of potash for K. The physical and chemical properties of vermi compost and FYM were analyzed in the laboratory following standard methodologies and are presented in Table 2. Before sowing of sweet corn (*Zea mays* L var. Suger-75) and sowing of potato (*Solanum tuberosum* L. var. K. Jyoti) in rainy and winter seasons respectively. The required quantity of different manures viz. vermi compost and FYM as per the treatments was applied in field ten days before sowing of both the crops. Forstudying the growth and yield attributes parameters of sweet corn and potato five plants were tagged randomly in second row of either side in the field. Dry matter accumulation (DMA) and leaf area studies were done from the randomly selected three plants from second row in sweet corn and potato and the yield and yield attributes were record at harvest.

Results and Discussion

Sweet corn

4.1.1 Growth parameters

Plant height, leaf area index (LAI) and dry matter accumulation (DMA) of sweet corn differed significantly due to application of varying sources and levels of nutrients during boththe years (Table 4.1.1).Among the INM treatments, the application of the various fertilizer levels to preceding sweet corn crop significantly influenced T_7 - 125% RDN + 25% N through V Cresulted in the highest plant height, LAI and DMA but these parameters were statistically at par that atresulted in the highest plant height, LAI and DMA but these parameters were statistically at par that at T_6 - 125% RDN + 25% N through FYM. The lowest plant height, leaf area index (LAI) and dry matter accumulation (DMA) was observed in treatment T_2 - 75% RDN +25% N through FYM, during 2014 and 2015 years, respectively. The vermi compost showed the superiority over the FYM at three the levels. vermi compost, a mixture of worm casts, is rich source of macro and micro nutrients andgrowth hormones which not only supplies essential nutrients to the soil but also improve the physico–chemical and biological properties of the soil (Sharma *et al*., 2005). Similar to vermi compost, FYM also contains different macro and micro nutrients and also helps in improving the soil physico–chemical and biological properties (Rawat and Pareek, 2003) [21]. Application of organic manures and bio fertilizers might have the improved physico–chemical properties and slow release of nutrients over longer period with theuses of organic sources might be responsible for better growth of popcorn plants with FYM and vermi compost application. The improvement in plant height and LAI with the use of organic sources consequently enhanced the DMA/plant. These results corroborate the findings of Jayaprakash *et al*. (2004) [11] and Kumar *et al*. (2007) [17]. However, days to 50% tasseling and 50% silking ha^{-1} could be affected significantly by different levels and sources of nutrients during both the years. While, the treatment T_2 exhibits, earliest 50% days to flowering these might be due to plant come in reproductive phase earlier as less nutrients availability at initial stage. There was conspicuous effect of different treatments on yield attributes of sweet corn.

4.1.2 Yield attributes

The length and girth of cob, grains/cob, cobs/ha and shelling percentage differed significantly due to varying sources and levels of nutrients (Table 4.1.2, 4.1.3) during each year. The application of treatment T_7 - 125% RDN + 25% N through VC recorded significantly highest values of all yield attributing parameters during both the years. Probably due to more absorption and utilization of available nutrients leading to overall improvement of crop growth reflected to source–sink relationship, which in turn enhanced the yield attributes of sweet corn during both the years. Among the INM sources of nutrients, application of vermicom post equivalent toT_7 - 125% RDN + 25% N through VC resulted in the highest cob length and girth, grain $cobs^{-1}$ and cobs ha^{-1} but these yield attributing characters were statistically at par with application ofT_6 -125% RDN + 25% N through FY Mtreatment levels. Higher LAI might have improved the values of yield attributes with application of vermicom post.

4.1.3 Yield

Perusal of the results of green cobs and fodder yield revealed that the treatment T_7 - 125% RDN + 25% N through VC recorded significantly the maximum green cob yield and green fodder yield higher over the rest of treatments, but it was at par with T_6 -125% RDN + 25% N through FYM in the pooled analysis during both the years (Table 4.1.3). The pronounced effect of integrated nutrient management on green cobs yield reflects the increased in growth and yield attributes of sweet corn, resulted in higher green cobs yield and fodder yield. This might be due to all the growth and yield attributes as well as favorable physiological and microclimatic characteristics were found maximum in above reported fertilizer levels which was reflected in higher green cob yield and green fodder yield of sweet corn was very highly fertilizer responsive crop. This is due to adequate supply of photo synthates for development of sink and balanced nutrition with integrated N management improved individual plant performance. Further vermi compost application increased green cobs yield numerically over FYM application. These might be due to vermicom post which improved the soil fertility where all the appropriate nutrients are in readily available forms to the plants and have narrow C:N ratio (below 20:1) than FYM. These results are in accordance with the findings by Shambhavi and Sharma (2008) [23]. It might due be to increased nutrients availability, which resulted in greater assimilation, production and partitioning of dry matter yield. Application of NPK fertilizers at the different levels had significantly effect on the growth and yield of maize (Kolawole and Joyce, 2009) [14]. The higher yield observed with the application of vermi compost in comparison to FYM may be explained on the basis of higher nutrient content, faster decomposition and release higher amount of nutrients in vermi compost beside enhancing the microbial population and higher root biomass (Kunnan *et al*., 2005) [18]. The considerable improvement in yield due to application of organic sources might be attributed to the fact that organic sources of nutrients had the positive effect on yield attributes and cumulative effect of yield attributes mainly responsible for higher productivity with the application of organic sources. The results are in accordance of Meena *et al.* (2007) [19].

Potato

4.1.4 Growth parameters

Plant height, LAI, and DMA in haulms differed significantly on residual fertility and with direct application of various levels and sources of nutrients during both the years (Table 4.1.4). On the residual fertility of FYM equivalent to 100% GRDF, potato plant recorded the highest plant height, LAI and DMA in haulms. This was because of higher residual availability of macro and micro nutrients under organic sources of nutrients *viz*., FYM. Similar positive residual effect of organic sources applied to previous crop on succeeding crop was reported by Jamwal (2005) [10] and Kumar (2008). In terms of growth parameters of potato all the nutrient levels and sources of nutrients applied to previous sweet corn crop comprising organic sources is better substitution of chemical fertilizers regarding to residual effects. Application of organic sources of nutrients to potato improved its growth parameters during both the years (Table 4.1.4). Application of FYM equivalent to 100% GRDF recorded the highest plant height, LAI and DMA in haulms. It might be due to improving soil structure, enhanced the water holding capacity, soil microbial activity and available soil nutrients like NPKS to plants with the application of FYM (Ayyub *et al*., 2011) [3].

4.1.5 Yield attributes

The yield attributes of potato *viz*. number of tubers/hill, fresh and dry weight of potato tubers were significantly affected with the residual and direct application of various levels and sources of nutrients during both the years (Table 4.1.4). The highest values of yield attributes of potato were recorded on the residual fertility of FYM (100% GRDF) which was statically at par to the residual fertility of T_6 – 125% RDN + 25% N through FYM during 20014–15 and 2015–16 years. The maximum number of tubers/hill, fresh tuber weight and dry tuber weight were with residual fertility of FYM equivalent to 100% GRDF could be due to continuous availability of nutrients and release macro and micro nutrients with other growth promoting substances to the crop. Although, on the residual fertility of vermin compost at all levels, lower values of yield attributes were noticed. The higher yield attributes of potato with the use of FYM in comparison to VC may be explained on the basis the superiority of FYM was attributed to its slow decomposition (Singh *et al.*, 1996), which caused immobilization of nitrogen and low availability of nitrogen for the sweet corn crop found to be reversed during the succeeding potato cropand improved physical and microbial activity with FYM application (Das *et al*., 2002) [5].

4.1.6 Yield

The potato tuber and haulms yield were significantly differed with residual fertility and direct application of varying sources and levels of nutrients during both the years (Table 4.1.7). The highest tuber and haulms yield were recorded on the residual fertility of FYM application 100% GRDF which remained at par with that on residual fertility of T_6 – 125% RDN + 25% N through FYM. Among the different residual fertility levels, vermi compost at three levels (75, 100, 125 RDN/ha) recorded the lower values of tuber and haulms yield than FYM. The positive effect of residual fertility of organic manures FYM to previous crop on the tuber yield of potato may be attributed higher residual availability of essential nutrient compared to vermi compost. Inaddition of these ingredients FYM also supplies growth hormones, enzymes, antibiotics and vitamins (Bhawalker, 1991) [4]. It might be due to more supply of macro and micro nutrients and better soil physical health for development of tuber with application of FYM (Zaman *et al*., 2011). With nutrition point of view, it was observed that increase in tuber yield due to integration of synthetic fertilizers and farmyard manure might regulated supply of nutrients to potato crop through readily available nutrients from synthetic fertilizers at initial stage and later stages through mineralization of organic manure into available form of nutrients for crop (Saravanane *et al.*, 2011, Kumar *et al*., 2012) [22, 12]. Similarly, integrated use of inorganic and organic sources of nutrients significantly improved the yield of potato.

Table 1: Details of the treatment and symbol used

Sr. No.	Treatment details	Symbol
A	**Main plot treatments (*Kharif* season sweet corn)**	
1	100% GRDF	T_1
2	75% RDN + 25% N through FYM	T_2
3	75% RDN + 25% N through vermi compost	T_3
4	100% RDN + 25% N through FYM	T_4
5	100% RDN + 25% N through vermi compost	T_5
6	125% RDN + 25% N through FYM	T_6
7	125% RDN + 25% N through vermi compost	T_7
GRDF (120:60:40 N, P_2O_5, K_2O kg ha^{-1} + 10 t FYM ha^{-1})		
B	Sub Plot Treatments (*Rabi* season potato)	
1	75% GRDF (112:60:90 kg N, P_2O_5, K_2O ha^{-1}+ 22.5 t FYM ha^{-1})	F_1
2	100% GRDF (150:80:120 kg N, P_2O_5, K_2O ha^{-1} + 30 t FYM ha^{-1})	F_2

(A common seed treatment with *Azotobacter*+ PSB also given to all treatments at the time of sowing)

Table 2: Chemical properties of FYM and vermi compost

Sr. No.	Particular	Composition	Method adopted	References
(A)	**Chemical properties of FYM**			
1	Total N (%)	0.50	Macro-kjeldhals method	A.O.A.C. (1992)
2	Total P_2O_5 (%)	0.20	Vanadomolybdate yellow colour method in nitric acid	Jackson (1973)
3	Total K_20 (%)	0.44	Flame photometer method	Knudsen *et al.* (1982)
(B)	**Chemical properties of vermi compost**			
1	Total N (%)	1.02	Macro-kjeldhals method	A.O.A.C. (2005) [2]
2	Total P_2O_5 (%)	0.50	Vanadomolybdate yellow colour method in nitric acid	Jackson (1973)
3	Total K_20 (%)	0.80	Flame photometer method	Knudsen *et al.* (1982)

Table 3: Growth attributes of sweet corn as influenced periodically by different treatments

Treatment		Growth attributes											
		Plant height (cm) plant^{-1} (at maturity)		Number of functional leaves plant^{-1}		Leaf area (dm^2) plant^{-1} (at 70 DAS)		Dry matter (g) plant^{-1} (at maturity)		Days to 50% tasseling		Days to 50% silking	
		2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Fertilizer Levels													
T_1:	100%GRDF	176.48	180.64	12.98	12.23	36.08	36.52	312.09	321.21	50	47	54	52
T_2 :	75% RDN+25%N through FYM	165.57	167.59	11.91	11.55	32.45	33.35	287.43	290.55	46	45	50	50
T_3 :	75% RDN+25%N through VC	167.00	168.52	12.75	11.66	33.73	34.27	296.93	305.29	47	46	51	50
T_4 :	100% RDN+25%N through FYM	169.63	171.37	12.82	11.91	34.76	36.29	299.13	314.11	47	46	52	51
T_5 :	100% RDN + 25% N through VC	171.53	172.42	12.83	12.11	35.91	36.32	302.67	317.91	49	46	53	51
T_6 :	125% RDN + 25% N through FYM	177.35	185.62	13.35	12.72	36.62	37.98	315.91	331.63	51	47	56	53
T_7 :	125% RDN + 25% N through VC	181.32	187.61	13.69	12.91	37.23	38.41	318.99	341.77	52	48	56	55
	S. Em. ±	1.33	1.34	0.16	0.08	0.38	0.50	1.07	3.40	0.22	0.27	0.33	0.46
	C. D. at 5%	3.99	4.03	0.45	0.24	1.12	1.48	3.18	10.2	0.65	0.81	0.98	1.38
	General mean	172.70	176.25	12.90	12.16	35.25	36.16	304.74	317.50	48.83	46.54	53.32	51.70

Table 4: Yield attributes of sweet corn as influenced periodically by different treatments

Treatment		Yield attributes											
		Length of cob with husk (cm)		Girth of cob with husk (cm)		Weight of cob with husk plant^{-1} (g)		Weight of grains per cob		Number of grain lines cob^{-1}		Number of grains cob^{-1}	
		2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Fertilizer Levels													
T_1:	100%GRDF	27.88	29.65	21.91	22.83	303.14	311.37	200.89	201.54	17.84	18.04	667.75	703.92
T_2:	75% RDN+25%N through FYM	26.37	27.57	21.35	21.47	286.98	291.33	188.35	189.19	17.23	17.60	612.35	664.05
T_3:	75% RDN+25%N through VC	26.71	27.65	21.45	21.58	290.01	298.55	191.13	193.24	17.33	17.89	619.37	681.25
T_4:	100% RDN+25%N through FYM	26.79	28.41	21.57	21.62	294.31	304.21	193.70	195.27	17.67	17.71	655.03	678.29
T_5:	100% RDN + 25% N through VC	27.23	29.51	21.79	21.88	302.28	308.76	200.37	199.75	17.78	17.87	661.42	685.31
T_6:	125% RDN + 25% N through FYM	28.46	29.78	22.28	22.94	304.25	314.62	201.21	202.24	18.33	18.53	702.41	724.15
T_7:	125% RDN + 25% N through VC	28.55	29.80	22.36	22.97	308.65	320.26	203.41	204.82	18.44	18.65	712.71	731.64
	S. Em. ±	0.22	0.04	0.13	0.04	0.89	1.14	0.81	0.85	0.13	0.14	11.08	9.22
	C. D. at 5%	0.65	0.11	0.39	0.12	2.68	3.41	2.41	2.52	0.38	0.41	33.23	27.65
	General mean	27.43	28.91	21.82	22.18	298.52	307.01	197.01	198.01	17.80	18.04	661.58	695.52

Table 5: Cob, fodder, biological yield and harvest index of sweet corn as influenced periodically by different treatments

Treatment		Green cob yield (q ha^{-1})		Green fodder yield (q ha^{-1})		Biological yield (q ha^{-1})		Harvest index (%)	
		2014	2015	2014	2015	2014	2015	2014	2015
Fertilizer Levels									
T_1 :	100%GRDF	265.25	271.99	527.85	540.80	793.10	812.79	33.44	33.46
T_2 :	75% RDN+25%N through FYM	249.75	256.25	509.49	520.66	759.24	776.91	32.89	32.98
T_3 :	75% RDN+25%N through VC	255.35	262.09	518.36	531.26	773.71	793.35	33.00	33.04
T_4 :	100% RDN+25%N through FYM	258.45	264.84	522.07	534.76	780.52	799.60	33.11	33.12
T_5 :	100% RDN + 25% N through VC	260.74	267.04	524.09	536.58	784.83	803.62	33.22	33.23
T_6 :	125% RDN + 25% N through FYM	271.94	277.49	538.44	546.82	810.38	824.31	33.56	33.66
T_7 :	125% RDN + 25% N through VC	275.55	281.55	542.83	554.19	818.38	835.74	33.67	33.69
	S. Em. ±	2.69	2.75	3.26	3.51	5.52	5.65	0.05	0.06

	C. D. at 5%	7.98	8.25	9.80	10.55	16.56	16.93	0.16	0.19
	General mean	262.43	268.75	526.16	537.87	788.59	806.29	33.27	33.33

Table 6: Direct and residual effects of varying levels and sources of nutrients on attributes of potato

Treatment		Growth attributes													
		Plant height (cm) (at maturity)		Number of functional leaves plant^{-1} (at 70 DAS)		Plant spread (cm) plant^{-1} (at 70 DAS)		Leaf area (dm^2) plant^{-1} (at 70 DAS)		Number of sprouts plant^{-1} (at 70 DAS)		Fresh weight of tubers (g) plant^{-1} (at maturity)		Total dry matter accumulation (g/hill) (at maturity)	
		2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
Fertilizer Levels to sweet corn															
T_1:	100%GRDF	43.24	46.14	92.87	95.87	29.85	32.68	71.92	66.56	4.59	4.47	333.87	337.02	84.84	85.37
T_2:	75% RDN+25%N through FYM	35.29	35.95	77.85	83.69	18.91	21.12	54.49	58.58	3.41	3.15	235.62	241.83	57.31	61.51
T_3:	75% RDN+25%N through VC	33.47	32.99	77.37	80.75	15.65	17.75	54.27	58.52	3.34	3.09	220.70	224.11	54.13	55.76
T_4:	100% RDN+25%N through FYM	37.03	38.11	83.52	86.72	20.42	21.92	56.67	61.73	4.15	3.99	266.39	280.45	70.10	71.10
T_5:	100% RDN + 25% N through VC	36.33	37.96	82.06	86.41	19.76	21.81	55.85	60.58	3.67	3.85	248.67	242.70	59.48	64.46
T_6:	125% RDN + 25% N through FYM	39.67	42.12	91.32	94.46	27.58	31.77	70.58	64.71	4.52	4.32	326.04	334.48	82.11	84.28
T_7:	125% RDN + 25% N through VC	38.11	39.22	86.66	87.31	26.42	28.10	69.36	63.21	4.41	4.01	285.97	291.55	72.65	73.70
	S. Em. ±	1.70	1.73	2.14	2.51	1.04	1.07	0.46	0.77	0.06	0.15	10.97	2.53	1.93	2.22
	C. D. at 5%	5.09	5.17	6.15	7.63	3.12	3.21	1.37	2.29	0.16	0.45	32.91	7.60	5.79	6.65
Fertilizer Levels to potato															
F_1:	75% GRDF	37.44	38.76	85.22	87.81	20.35	25.10	67.11	61.83	3.85	3.64	272.62	277.46	66.28	69.84
F_2:	100% GRDF	37.99	39.09	84.56	87.97	20.37	24.94	67.29	61.95	3.99	3.91	275.17	280.29	67.39	70.88
	S. Em. ±	0.55	0.56	0.24	0.23	0.28	0.29	0.21	0.29	0.02	0.12	3.69	1.97	0.86	0.52
	C. D. at 5%	NS	NS	N.S	N.S	N.S	N.S	NS	NS	N.S	N.S	NS	NS	NS	NS
	Interaction	NS	NS	N.S	N.S	N.S	N.S	NS	NS	N.S	N.S	NS	NS	NS	NS
	General mean	37.72	38.93	84.89	87.89	20.36	25.02	67.20	61.89	3.92	3.77	273.89	278.87	66.83	70.36

Table 7: Direct and residual effects of varying levels and sources of nutrients on tubers and haulms yield of potato

Treatment		Tuber yield (q ha^{-1})		Pooled mean (q ha^{-1})	Haulm yield (q ha^{-1})		Pooled mean (q ha^{-1})
		2014-15	2015-16		2014-15	2015-16	
Fertilizer Levels to sweet corn							
T_1 :	100%GRDF	280.21	286.96	283.58	12.31	13.52	12.92
T_2 :	75% RDN+25%N through FYM	260.35	272.35	266.35	10.46	10.54	10.50
T_3 :	75% RDN+25%N through VC	255.71	266.72	261.21	10.31	10.46	10.38
T_4 :	100% RDN+25%N through FYM	265.53	276.51	271.02	10.90	11.12	10.96
T_5 :	100% RDN + 25% N through VC	261.65	274.71	268.18	10.66	10.97	10.71
T_6 :	125% RDN + 25% N through FYM	275.36	282.11	278.74	11.17	12.26	11.71
T_7 :	125% RDN + 25% N through VC	271.55	278.95	275.25	11.06	11.17	11.11
	S. Em. ±	2.47	2.53	2.51	0.41	0.47	0.44
	C. D. at 5%	7.41	7.59	7.51	1.22	1.41	1.31
Fertilizer Levels to potato							
F_1 :	75% GRDF	264.66	274.75	269.71	10.69	10.95	10.82
F_2 :	100% GRDF	270.21	279.60	274.91	10.98	11.64	11.30
	S. Em. ±	2.44	1.04	1.28	0.13	0.11	0.24
	C. D. at 5%	NS	NS	NS	NS	NS	NS
	Interaction	NS	NS	NS	NS	NS	NS
	General mean	267.44	277.18	272.31	10.83	11.29	11.06

Conclusion

On the basis of the results illustrated from the present investigation it can be concluded that growth, yield attributes and yield of sweet corn were significantly highest with the application of among the organic sources of nutrients,T_7 - 125% RDN + 25% N through VC which remained statistically at par with the T_6 – 125% RDN + 25% N through FYM. The residual fertility of FYM equivalent to 100% GRDF recorded the higher values of growth parameters *viz*., plant height, LAI, number of haulms and DMA in haulms which remained statistically at par with the T_6 – 125% RDN + 25% N through FYM. Similar results were also recorded for yield and yield attributes *viz*., number of tubers/hill, fresh and dry weight of tubers, tuber yield and haulms yield.

Reference

1. AOAC. Official Methods of analysis. 16th Edn. Association of Official Analytical Chemists. Washington D.C, 1992.
2. AOAC. Official Methods of Analysis, Association of Official Agricultural Chemists, Washington, D.C, 2005.
3. Ayyub CM, Pervez MA, Ali S, Manan A, Akhtar N, Ashraf I *et al* Growth and yield response of potato crop to different sources of potash. Intern. J.r Agro–Vet. Medic. Sci. 2011; 5(3):283-288.
4. Bhawalker US. Vermiculture technology for LEISA. In: Seminar on Low External Input Sustainable Agriculture. Amsterdam, Netherland, 1991.
5. Das K, Medhi DN, Guha B, Baruah BK. Direct and residual effects of recycling of crop residues along with chemical fertilizers in rice–wheat cropping systems. Ann. Agric. Res. 2002; 23(3):415-418.
6. DMR. Directorate of Maize Research Vision– 2025, Indian Council of Agricultural Research, Pusa, New Delhi, 2011.
7. DMR. Directorate of Maize Research Vision 2030, Indian Council of Agricultural Research, Pusa, New Delhi, 2030.
8. FAI. Fertilizer Statistics 2009-10. The Fertilizer Association of India, New Delhi. 2010; II-48:63.
9. FAO. Food and Agriculture Organization, Selected indicators of food and agriculture development in Asia–Pacific Region, 1989–99. RAP publication No. 2000/15, 2000.
10. Jamwal JS. Productivity and economics of maize (Zea mays)–wheat (*Triticum aestivum*) cropping system under irrigated nutrient supply system in rainfed areas of Jammu. Indian J. Agron. 2005; 50(2):110-112.
11. Jayaprakash TC, Nagalikar VP, Pujari BT, Setty RA. Effect of organics and inorganics on soil properties and available nutrient status of soil after harvest of maize crop under irrigation. Karnataka J. Agric. Sci. 2004; 17(2):311-314.
12. Khurana PSM, Naik PS. The Potato: an overview. In the potato production and utilization in Sub– tropics (Edited by S. M. Paul Khurana, J.S Minas and S.K. Pandy) Mehta Publication, New Delhi, 2003, 1-14.
13. Knudsen D, Peterson GA, Pratt PF. Lithium, sodium and potassium. In A.L. Page *et al*. (Ed.) methods of soil analysis, part II. 2nd edn. Agron. Monogr. Madison. 1982, 225-246.
14. Kolawole EL, Joyce EL. The Performance of Zea mays as Influenced by NPK Fertilizer Application. Notulae Scientia Biol. 2009; 1(1):59-62.
15. Kumar A, Gautam RC, Singh R, Rana KS. Growth, yield and economics of maize (*Zea mays* L.)–wheat (*Triticum aestivum* L.) cropping sequences as influenced by integrated nutrient management. Indian J Agric. Sci. 2005; 75(11):709-711.
16. Kumar M, Baishya LK, Ghosh DC, Gupta VK. Yield and quality of potato (Solanum tuberosum) tubers as influenced by nutrient sources under rainfed condition of Meghalaya. Indian J. Agron. 2012; 56(3):260-266.
17. Kumar P, Singh H, Hooda RS, Singh VP. Effect of nitrogen levels and biofertilizers on productivity, soil properties and rhizosphere micro flora under pearl millet–wheat cropping system. Res. Crops. 2007; 8(1):72-76.
18. Kunnan P, Saravanan A, Krishnakumar S, Natarajan SK. Biological properties of soil as influenced by different organic manures. Res. J Agric. Biol. Sci. 2005; 1**(**2):181-183.
19. Meena O, Khafi HR, Shekh MA, Mehta AC, Davda BK. Effect of vermi compost and nitrogen on content, uptake and yield of rabi maize (*Zea mays* L.).*Crop Res. Hisar*. 2007; 33(1/3):53-54.
20. Pandey SK, Singh JP, Gopal J. Potato varieties and cropping systems in India. Potato J. 2008; 35(3, 4):103-110.
21. Rawat SS, Pareek RG. Effect of FYM and NPK on yield and nutrient uptake for soil fertility in wheat. Annals of Agri Bio Res. 2003; 8(1):17-19.
22. Saravanane P, Nanjappa HV, Ramachandrappa BK, Soumya TM. Effect of residual fertility of preceding potato crop on yield and nutrient uptake of finger millet. Karnataka J Agric. Sci. 2011; 24(2):234-236.
23. Shambhavi S, Sharma RP. Influence of vermi compost on quality of potato (*Solanum tuberosum)* in wet–temperate zone of Himachal Pradesh. Indian J Plant Physiol. 2008; 13(2):185-190.
24. Sharma RC, Sharma HC, Trehan SP, Singh JP. Results of permanent manorial trials at Jalandhar. Technical Bulletin No, 75, Central potato research institute, Shimla 2006, 43.