



P-ISSN: 2349-8528

E-ISSN: 2321-4902

IJCS 2020; 8(1): 1628-1634

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Received: 28-11-2019

Accepted: 30-12-2019

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Productivity, nutrient uptake and quality of sweet corn and potato in relation to integrated nutrient management practice

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DOI: <https://doi.org/10.22271/chemi.2020.v8.i1w.8495>

Abstract

Field 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 highest N, P and K content in grain and stover, total N, P and K uptake, protein content in grain of sweet corn were recorded in the treatment receiving T₇ – 125% RDN + 25% N through VC, which were statistically at par with T₆ – 125% RDN + 25% N through FYM. However, T₂ – 75% RDN + 25% N through FYM proved to be the poorest source in terms of total uptake of NPK nutrients and quality parameters. The highest N, P and K content and total nutrient uptake in potato tuber and haulms and quality parameters of tubers were recorded in the plots with residual fertility of T₁ – 100% GRDF, which was at par T₆ – 125% RDN + 25% N through FYM. Application of FYM to preceding sweet corn led to significantly higher nutrient content and total N, P and K uptake in tuber and haulms of tubers during both the years.

Keywords: Farmyard manure, nutrient uptake, sweet corn, potato, quality, vermicompost, yield

Introduction

Enhancing sustainable agricultural production is of utmost importance for India's food and nutritional security. Though India is a food surplus nation at present with about 264.8 million tonnes of food grain production per annum, it is anticipated that the total food grain demand of our country will reach 291 million tonnes in 2050 (Kumar and Shivay, 2010) [18]. Sweet corn a crop of commercial and industrial usage, is a viable option to replace rice in rice-wheat growing region. It is gaining popularity due to high yield, easy processing, easy digestibility and less production costs than other cereals (Jaliya *et al.*, 2008) [11]. Potato is another commercial crop of Indo-Gangetic plains and most commonly grown after corn and it requires an optimal supply of nutrients throughout the growing season to sustain their growth and tuber development (Singh and Trehan, 1998) [33]. Both of these crops are nutrient exhaustive crops. The productivity both of sweet corn and potato is largely dependent on its nutrient management. Heavy fertilization will not only deteriorate the soil health but also caused several environment hazards. Further, the quality of crop produce also depends on sufficient and timely supply of nutrients in sufficient quantity. Therefore, the application of scientific approaches and judicious use of organic manures are the alternative options for sustainable production that focuses on soil quality by largely excluding the use of inorganic sources of nutrients. Use of available organic manures without any chemical fertilizer and other agro-chemicals is believed to result in better quality produce without any harmful residues, regulated and continued release of nutrients in soil without any environmental hazards, and sustained productivity (Bhattacharyya *et al.*, 2005) [4]. It is worth mentioning here that vermicompost and farmyard manure represent emerging manures in present day agriculture. Hence, the present investigation involves the assessment of response of sweet corn and potato to different organic sources of nutrients in varying quantity.

Materials and Methods

The field experiment was conducted for two consecutive years at the Post Graduate Institute Research Farm, M.P.K.V., Rahuri (M.S.) during the year 2014-15 and 2015-16.

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It is observed that, the soil of experimental site was clayey in texture. The chemical composition according criteria laid by Muhr *et al.* (1965)^[24] indicated that soil was low in available nitrogen (241.35 kg ha⁻¹), medium in available phosphorous (22.85 kg ha⁻¹) and very high in potassium (365.75 kg ha⁻¹). The soil was moderately alkaline in reaction (pH 8.2) with an electrical conductivity of 0.33 dSm⁻¹. The field capacity and permanent wilting point was 39.42 and 21.28 per cent, respectively with bulk density 1.39 Mg m⁻³. The experiment was laid out in a Randomized Block Design with three replications. The treatment consisted T₁ – 100% GRDF, T₂ - 75% RDN + 25% N through FYM, T₃ - 75% RDN + 25% N through VC, T₄ – 100% RDN + 25% N through FYM T₅ - 100% RDN + 25% N through VC, T₆ – 125% RDN + 25% N through FYM and T₇ – 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., F₁ - 75 per cent GRDF and F₂ - 100 per cent 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 required quantity of different manures viz. FYM and vermicompost as per the treatments was applied in the field ten days before sowing of both the crops. The available N, P and K content were 1.02, 0.50 and 0.80% in vermicompost, 0.50, 0.20, and 0.44% in FYM. In doing so the respective contribution of P and K from vermicompost and FYM was also considered. The fertilizers used were urea for N, single superphosphate for P, and muriate of potash for K. The seed of sweet corn var. Suger-75) was dibbled on the ridge sides at a spacing of 20 cm at 4 cm depth and required plant population (83,000 plant ha⁻¹) was maintained by thinning of plants after one week of germination. Similarly, potato var. K. Jyoti seed tubers of 25–30 cm size were sown 5 cm deep on the south side of the ridges at a spacing of 20 cm between tubers in rainy and winter seasons respectively. The chemical analysis of plant was done for N, P and K concentration in grain and stover of sweet corn and tuber and haulms of potato as per the standard analysis methods (Prasad *et al.*, 2006)^[28]. The freshly harvested sweet corn grain samples were analyzed for reducing sugar content by using Fehling's method. The non reducing sugar per cent was observed by substituting the reducing sugar from total sugar per cent by using formula: Non-reducing sugar = Total sugar - Reducing sugar x 0.95. Total sugar per cent was estimated by using phenol sulphuric acid by Dubois method (Sadasivan and Manickam, 1996)^[30] and starch content by using anthrone method (Clegg, 1956)^[5]. The starch content of plant samples was estimated as per the procedure given for reducing sugars by Somogys method and glucose was used as a standard. The amount of glucose equivalent was multiplied by 0.90 to get starch content (Powell, 1973)^[26]. Uptake by plants was calculated by multiplying dry matter yield/ha with corresponding values of their concentration divided by 100 and were expressed as kg/ha. Protein concentration in cobs of sweet corn was calculated by multiplying the N concentration by a factor of 6.25.

Results and Discussion

Sweet corn

Yield

Perusal of the results of green cobs revealed that the treatment T₇ - 125% RDN + 25% N through VC recorded significantly the maximum green cob yield higher over the rest of treatments, but it was at par with T₆ -125% RDN + 25% N

through FYM in during both the years (Table 1). 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 vermicompost application increased green cobs yield numerically over FYM application. These might be due to vermicompost 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)^[32]. It might due be to increased nutrients availability, which resulted in greater assimilation, production and partitioning of dry matter yield. The higher yield observed with the application of vermin 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 (Kannan *et al.*, 2005)^[12]. 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)^[23].

Quality parameters

Data revealed that the treatment the quality parameters was significantly influenced due to different treatments during both the years of experiment (Table 1). The application of T₇ - 125% RDN + 25% N through VC to sweet corn recorded significantly highest protein content. Nitrogen, being the principle constituent of protein might have substantially increased the protein content of kernel due to increased uptake of nitrogen under higher nutrient level when integrated with vermicompost compounds. Thus, better physiological and bio chemical activity of sweet corn under adequate and balanced nutrient supply might have enhanced the protein content of kernel as was also confirmed by Kar *et al.*, (2006)^[14] and Keerthi *et al.*, (2013)^[16]. Data pertaining to starch, reducing sugar, non reducing sugar and total sugar in cob of sweet corn as affected by different treatments (Table 1). At harvest treatment T₇ -125% RDN + 25% N through VC recorded were significantly found to be have excellent sweetness over rest of treatments and was at par with treatment T₆ -125% RDN + 25% N through FYM. This might be a reason of higher total sugar and sugar acid ratio. The reducing sugar, non-reducing sugar and total sugar content of maize grains in the present study corroborate well with ranges reported by Arun Kumar *et al.*, (2007)^[1]. This finding closely associated with that the vermicompost recorded significantly higher protein content Ramesh *et al.*, (2008)^[29] and Meena *et al.*, (2007)^[23].

Sweet corn nutrient concentration

The various levels and sources of nutrients applied to preceding sweet corn nutrient concentration was registered by

treatment T₇- 125% RDN + 25% N through VC during both the years of experimentation (Table 2). Among the organic sources, application of that the treatment T₇ - 125% RDN + 25% N through VC recorded the highest values of N, P and K concentration in grain and stover and protein content in grain but these were statistically at par that with of T₆ -125% RDN + 25% N through FYM (Table 2). The organic sources such as vermicompost are the store house of nutrients and release nutrients for a long duration at slow rate during crop growth period, as and when required. The higher concentration of N, P and K to be attributed to higher availability and synergistic effects of these nutrients to each other at all the stage of crop growth. It was also observed that concentration of the nutrient bearing potash was higher in grain than stalk which ascribed to the translocation of N, P and K from vegetative part of crop plant to grain at the time of maturity. Unlike the higher concentration of N, P in grain content of K reported higher in stalk, this may be due to the fibrous cells which are usually in sclerenchyma cells and they tend to respond to potassium supply. K supply results in relatively high turgidity and high content of cellulose and hemicelluloses associated with high content of K in stalk. Similar results are also reported by other workers Karki *et al.* (2005) [15], Mann *et al.* (2006) [21] and Vikas *et al.* (2007) [38]. The treatment T₂ - 75% RDN + 25% N through FYM registered lowest nutrient concentration and the quality parameters while higher starch content.

Nutrient uptake

Impact of INM on nutrient uptake at harvest in grain and stover of sweet corn was significantly influenced by varying sources and levels of nutrients and was higher over the control during both the years (Table 3). The treatment T₇ - 125% RDN + 25% N through VC registered significantly maximum total nitrogen, phosphorus and potassium uptake than to rest of the treatments and followed by treatment T₆- 125% RDN + 25% N through FYM during first and second years, respectively. The minimum total nitrogen, phosphorus and potassium uptake was recorded in treatment T₂ - 75% RDN + 25% N through FYM ha⁻¹ treatment respectively during first and second years of study. The best source among all organic sources having higher N uptake in grain and stover. This was due to the benefits of organic manures, which release nutrients slowly for a long time and make them available to the plant for their uptake (Vidyavathi *et al.*, 2011) [37]. While, N uptake was highest with the application of T₇ - 125% RDN + 25% N through VC, which was ascribed to higher N concentration and dry matter yield due to more supply of N at FYM level. Maize being an exhaustive crop removes higher amount of nutrients from soil and also its higher biomass yield contributes to the higher uptake of nutrients. Increased yield and nutrient content in plant resulted in higher uptake (Prasad *et al.*, 2010) [27]. It might be due to the additional amount of P supplied by vermicompost as well as the beneficial effect of organic matter addition derived in connection with the improvement in physico-chemical properties of the soil. In addition K in soil its higher availability to plant system, which encourages robust root system resulting in better absorption of water and nutrient from lower layers and thus resulting in higher yield and nutrient uptake (Kumar *et al.*, 2003) [17]. These results are in close conformity with the findings of Sujatha *et al.* (2008) [36], Makinde and Ayoola (2010) [20].

Total tuber yield

The potato tuber yield were significantly differed with residual fertility and direct application of varying sources and

levels of nutrients ((Table 4). The highest tuber and haulm yields were recorded on the residual fertility of FYM application treatment T₁-100% GRDF recorded significantly superior total tuber yield and haulms yield than rest of the treatments and was at par with treatment T₆-125% RDN + 25% N through FYM. The lowest total tuber yield was observed in treatment T₃ - 75% RDN + 25% N through VC during both the years and in pooled mean. Application of FYM to the preceding sweet corn crop recorded higher tuber yield and the magnitude of yield increase was over the application of NPK through VC. The increase in tuber yields under these treatments was the reflection of improved growth, yield parameters and nutrient uptake of the crop. The superiority of FYM was attributed to its slow decomposition (Singh *et al.*, 1996) [35], which caused immobilization of nitrogen and low availability of nitrogen for the sweet corn crop found to be reversed during the succeeding potato crop. Kapur and Rana (1980) [13] also reported that only 30% of N, 66% of P and 70% K from FYM is likely to be used by the first crop, the remaining may be available to the second crop.

Quality parameters

The starch content and protein content of tuber as influenced by integrated nutrient management practices did not show significance difference among the treatments to preceding sweet corn crop ((Table 4). However, the treatment T₁-100% GRDF recorded the higher starch content over rest of treatments followed by treatment T₆-125% RDN + 25% N through FYM. It may be due to the fact that organic manure supplies all the growth principles, as a result metabolic function is regulated resulting in the better synthesis of carbohydrate, protein, fats and starch etc. Whereas, nitrogen is a major component of protein. Nitrogen is a vital role in plant that associated directly and indirectly with protein synthesis and it was significantly increased with increasing of nitrogen doses. These results are also confirmed with other investigators such as Danilchenko *et al.* (2009). Regarding the tubers quality as expressed as starch percentage, crude protein percentage and dry matter percentage showed positively responses to the different farmyard manure levels where the highest values of them were noticed with the highest farmyard manure level which consequently increased photosynthesis efficiency and synthesis of carbohydrates such as starch content which reflected on increasing of tubers yield of plants. These results are also confirmed Matiwas Taye (2011) [22] and Bashir and Qureshi (2014) [2].

Potato nutrient concentration

The various levels and sources of nutrients applied to preceding sweet corn had significant effect on N, P and K content in tuber and haulms of potato (Table 5). The highest N, P and K content in potato tuber and haulms were recorded by fertilizer levels to preceding sweet corn crop and the treatment T₁-100% GRDF than rest of other treatments and at par with the treatment T₆ -125% RDN + 25% N through FYM in during both the years. The lowest nutrients N, P and K content by tubers and haulms were recorded in the treatment T₃ - 75% RDN + 25% N through VC during both the years. It might be due to attributed to increased rate of mineralization of the organic manure with addition of FYM in this soil, resulting into nutrient transformations and their mobility into the plant system for longer period (Laxminarayana *et al.*, 2011) [19]. The residual effect of all the organic sources of nutrients showed superiority over the treatment receiving through VC in term of N, P and K content in potato tubers and

haulms. The organic sources of nutrients (FYM and vermicompost) are the storehouse of nutrients and constant nutrient release pattern from organic sources to crop plants resulted in increased availability of nutrients to succeeding potato. Nutrients contents in tuber and haulms of potato were significantly varied due to direct application of organic manures i.e. various levels of FYM to potato. It might be due higher availability of nutrients to plant, which is directly related to nutrients content in plant and being involved in physico-chemical reaction of plant body of potato did behave accordingly to their effect on plant system and enhanced the values of quality parameters.

Nitrogen uptake

Nitrogen uptake significantly higher N uptake in tuber and haulms was recorded with the residual fertility through FYM, which remained at par with vermicompost at same levels of nutrients (Table 6). This was due to the increased dry matter production of potato crop, which in turn increased uptake of N. Improvement of N uptake due to residual effect of organic manures was reported by Cooper band *et al.*, (2002) [6]. It might be attributed well established developed root system, additional nutrients supply by FYM, significant improvement in soil physical properties, microbial and metabolic activity, and higher photosynthesis rate, which may have helped in better absorption of nutrients by plant (Parmar *et al.*, 2007) [25].

Phosphorus uptake

The uptake of P in tuber and haulms of potato was enhanced under the residual fertility of various levels and sources of nutrients during both the years (Table 6). Significantly highest P uptake in tuber and haulms of potato recorded on the residual nutrients of the treatment T₁-100% GRDF which

remained at par with of treatment T₆ - 125% RDN + 25% N through FYM. Increased in P uptake by the residual fertility of organic nutrients might be due to longer and persistent supply of nutrients at higher levels resulted into greater translocation of photosynthesis for longer duration which results into higher P uptake in tuber and haulms of potato (Saravanane *et al.*, 2011) [31]. The lowest mean phosphorus uptake was observed in treatment T₃ - 75% RDN + 25% N through VC during both the years. When FYM was applied, P uptake increased significantly with increasing FYM level in potato (Dua *et al.*, 2010) [9]. Higher biomass production may be the most pertinent reason for higher uptake of P with the application of organic manures. It might be due to increase the vegetative growth and root biomass and increased the availability nutrients in soil resulting in higher uptake of nutrients. This enhanced the vegetative growth which ultimately increased P in total biomass of plants.

Potassium uptake

The highest K uptake in tuber and haulms of potato was recorded with the residual effect of the treatment T₁ - 100% GRDF which remained at par with treatment T₆ - 125% RDN + 25% N through FYM (Table 6). The higher response to the organic sources might be attributed to the nature and amount of nutrients present in the manures and their decomposition and nutrient release pattern in the soils, which translocation into plant (Laxminarayana *et al.*, 2011) [19]. Application of FYM recorded higher K uptake in tuber and haulms by potato over the lower level of VC. It might be due to beneficial effect of organic matter addition derived in connection with the improvement in physico-chemical properties of the soil was the reason of higher nutrient uptake. These findings are inconformity with the observations of Datt *et al.* (2003) [8] and Bhatt *et al.* (2004) [3].

Table 1: Green cob yield and quality parameters of sweet corn as influenced by different treatments

Treatment	Green cob yield (q ha ⁻¹)	Protein (%)	Starch (%)	Reducing sugar (%)	Non reducing sugar (%)	Total Sugar (%)	Green cob yield (q ha ⁻¹)	Protein (%)	Starch (%)	Reducing sugar (%)	Non reducing sugar (%)	Total Sugar (%)
Fertilizer Levels												
T ₁ : 100% GRDF	271.99	11.50	50.91	3.67	8.40	12.51	271.99	11.38	51.90	3.69	8.53	12.67
T ₂ : 75% RDN + 25% N through FYM	256.25	10.56	49.38	3.63	7.32	11.34	256.25	10.50	50.64	3.64	7.34	11.37
T ₃ : 75% RDN + 25% N through VC	262.09	10.81	49.97	3.64	7.44	11.47	262.09	10.81	50.82	3.66	8.24	12.33
T ₄ : 100% RDN + 25% N through FYM	264.84	11.25	50.61	3.65	7.86	11.92	264.84	11.13	51.54	3.67	8.15	12.25
T ₅ : 100% RDN + 25% N through VC	267.04	11.44	50.75	3.66	8.31	12.41	267.04	11.25	51.60	3.68	8.42	12.54
T ₆ : 125% RDN + 25% N through FYM	277.49	11.63	52.14	3.69	8.47	12.61	277.49	11.56	52.55	3.70	8.61	12.76
T ₇ : 125% RDN + 25% N through VC	281.55	12.01	52.86	3.70	8.64	12.79	281.55	11.81	52.97	3.72	8.81	12.99
S. Em. ±	2.75	0.11	0.38	0.006	0.07	0.08	2.75	0.09	0.39	0.005	0.076	0.09
C. D. at 5%	8.25	0.34	1.14	0.01	0.21	0.24	8.25	0.26	1.18	0.01	0.22	0.26
General mean	268.75	11.33	50.95	3.66	8.49	12.15	268.75	11.21	51.72	3.68	8.74	12.42

Table 2: Nutrient concentration in sweet corn at harvest influenced by different treatments

Treatment	Nitrogen (%)				Phosphorus (%)				Potassium (%)			
	Grain		Stover		Grain		Stover		Grain		Stover	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Fertilizer Levels												
T ₁ : 100% GRDF	1.84	1.83	0.83	0.85	0.19	0.19	0.15	0.14	0.40	0.40	0.85	0.84
T ₂ : 75% RDN + 25% N through FYM	1.69	1.68	0.70	0.67	0.18	0.18	0.14	0.13	0.35	0.36	0.80	0.79
T ₃ : 75% RDN + 25% N through VC	1.73	1.73	0.73	0.73	0.18	0.18	0.14	0.13	0.37	0.37	0.81	0.81
T ₄ : 100% RDN + 25% N through FYM	1.80	1.78	0.78	0.76	0.18	0.19	0.15	0.14	0.38	0.38	0.82	0.82
T ₅ : 100% RDN + 25% N through VC	1.83	1.80	0.79	0.79	0.19	0.19	0.15	0.14	0.39	0.39	0.83	0.83

T ₆ :	125% RDN + 25% N through FYM	1.86	1.85	0.86	0.87	0.19	0.20	0.16	0.15	0.41	0.41	0.87	0.86
T ₇ :	125% RDN + 25% N through VC	1.92	1.89	0.92	0.90	0.20	0.22	0.17	0.16	0.42	0.42	0.90	0.87
	S. Em. ±	0.019	0.013	0.017	0.008	0.002	0.002	0.003	0.001	0.002	0.002	0.006	0.012
	C. D. at 5%	0.057	0.037	0.052	0.024	0.007	0.006	0.009	0.003	0.006	0.007	0.018	0.036
	General mean	1.81	1.79	0.80	0.79	0.19	0.19	0.15	0.14	0.4	0.39	0.84	0.83

Table 3: Nutrient uptakes by sweet corn at harvest as influenced by different treatments

Treatment	Nitrogen (kg ha ⁻¹)				Phosphorus (kg ha ⁻¹)				Potassium (kg ha ⁻¹)				
	Grain		Stover		Grain		Stover		Grain		Stover		
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	
Fertilizer Levels													
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												
T ₇ :	125% RDN + 25% N through VC												
	S. Em. ±												
	C. D. at 5%												
	General mean												

Table 4: Total tuber yield, starch and protein content in tubers at harvest as influenced by different treatments

Treatment	Tuber yield (q ha ⁻¹)		Starch (%)		Protein (%)	
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
Fertilizer levels to sweet corn						
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					
T ₇ :	125% RDN + 25% N through VC					
	S. Em. ±					
	C. D. at 5%					
Fertilizer levels to potato						
F ₁ :	75% GRDF					
F ₂ :	100% GRDF					
	S. Em. ±					
	C. D. at 5%					
	Interaction					
	General mean					

Table 5: Nutrient concentration of potato tubers and haulm as influenced by different treatments

Treatment	Nutrient concentration (%)											
	Nitrogen				Phosphorus				Potassium			
	Tubers		Haulm		Tubers		Haulm		Tubers		Haulm	
	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											
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											
T ₇ :	125% RDN + 25% N through VC											
	S. Em. ±											
	C. D. at 5%											
Fertilizer levels to potato												
F ₁ :	75% GRDF											
F ₂ :	100% GRDF											
	S. Em. ±											
	C. D. at 5%											
	Interaction											
	General mean											

Table 6: Nutrient uptake by potato tubers and haulm as influenced by different treatments

Treatment	Nutrient uptake (kg ha ⁻¹)												
	Nitrogen				Phosphorus				Potassium				
	Tubers		Haulm		Tubers		Haulm		Tubers		Haulm		
	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	116.28	117.55	10.74	11.35	16.35	16.44	3.67	3.87	130.32	130.69	21.28	153.13
T ₂ :	75% RDN + 25% N through FYM	75.57	82.11	6.81	6.56	10.18	11.32	2.26	2.24	74.48	78.76	12.91	91.36
T ₃ :	75% RDN + 25% N through VC	69.06	73.76	6.53	5.83	9.28	9.63	2.25	1.95	68.91	71.81	12.50	82.82
T ₄ :	100% RDN + 25% N through FYM	94.89	95.52	8.35	8.89	13.17	13.43	2.80	2.99	94.57	94.89	15.94	111.88
T ₅ :	100% RDN + 25% N through VC	79.28	86.83	7.04	7.47	11.06	11.84	2.38	2.52	80.20	87.42	13.38	101.60
T ₆ :	125% RDN + 25% N through FYM	112.78	116.13	9.95	10.32	15.73	16.19	3.40	3.56	125.71	127.66	19.16	147.74
T ₇ :	125% RDN + 25% N through VC	98.22	99.84	8.91	9.56	13.68	14.16	3.00	3.19	105.79	107.22	17.14	125.43
	S. Em. ±	1.09	1.11	0.11	0.11	0.25	0.26	0.23	0.22	1.81	1.81	1.01	1.86
	C. D. at 5%	3.31	3.31	0.32	0.32	0.75	0.78	0.65	0.65	5.43	5.43	1.03	5.58
Fertilizer levels to potato													
F ₁ :	75% GRDF	90.25	94.59	7.87	8.43	12.42	12.90	2.66	2.85	94.63	98.82	15.20	115.07
F ₂ :	100% GRDF	93.01	96.97	8.15	8.87	12.95	13.31	2.77	3.01	97.53	100.43	15.69	117.48
	S. Em. ±	0.40	0.42	0.08	0.09	0.18	0.19	0.04	0.06	0.85	0.86	0.22	0.49
	C. D. at 5%	1.20	1.24	0.24	0.27	0.54	0.57	0.12	0.18	2.55	2.58	0.63	1.44
	Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	General mean	91.63	95.78	8.01	8.65	12.68	13.11	2.72	2.93	96.08	99.62	15.44	116.28

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