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EFFECT OF NITROGEN AND FARMYARD MANURE ON YIELD, NUTRIENT CONTENT AND QUALITY OF POTATO (*SOLANUM TUBEROSUM L.*)

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ABSTRACT

A field experiment was conducted during the *Rabi* seasons 2004-05 on sandy clay loam to study the effect of nitrogen fertilizers and farmyard manure on yield, nutrient content and quality of potato (*Solanum tuberosum* L).The yield and quality of potato tubers were influenced by the rate of nitrogen and farmyard manure. Application of 180 kg N ha^{-1} along with 24 t FYM ha^{-1}gave significantly higher yield. The concentration of N, P and K in tubers increased with increasing levels of N and FYM. Addition of N and FYM significantly enhanced the quality of potato. Maximum carbohydrate, crude protein and ascorbic acid was recorded in the treatment combination of $N_{180}F_{24}$.

Key words: - FYM, potato, yield, Inorganic nitrogen, quality.

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INTRODUCTION

Potato (*Solanum tuberosum* L) an important vegetable crop in our diet. Potato produces more food per unit area and time compared to cereals. Tuber yield and quality responds significantly to nitrogen and farmyard manure application. The FYM may not meet the N requirement of potato as the nutrients become gradually available with its decomposition, whereas in fertilizers the availability of N gets reduced in latter stages of crop growth. Thus it has been realized that chemical fertilizers must be integrated through more economic and eco-friendly organic manure to achieve sustainable productivity with high quality and minimum deterioration of the environment (Belec*et al*, 2003).Hence a field investigation was initiated to evaluate the efficiency of nitrogen and farmyard manure alone or in combination on yield, nutrient content and important quality constituents of potato tuber.

MATERIALS AND METHODS

A field experiment was conducted during *rabi* season 2004-05 atCrop Research StationFarm of Department of Soil and Environmental Sciences, Allahabad Agriculture Institute Allahabad. The soil of experimental field was sandy clay loam in texture with pH of 7.90, EC of 0.39 $dSm^{-1}$and organic carbon of 0.60%. The availablenitrogen, phosphorusand potassium contents were 270, 27 and 260 $kgha^{-1}$respectively.The treatments consists of four levels each of inorganic nitrogen(0, 60, 120 and 180 kg N ha^{-1}) and farmyard manure (0, 8, 16 and 24 t ha^{-1}) were tried in randomized block design replicated thrice, adopting a plot size of 2.4m x 1m. A recommended dose of phoshoprus and potassium

respectively was applied through SSP and potash. The crop was allowed to grow up to maturity. At harvest the tuber yield was recorded. The tuber after digestion was analyzed for nutrientscontent by following standard. Nitrogen was estimated by Kjeldahl's digestionand distillation method (Jackson 1967), phosphorus by Vanadomolybdate method (Jackson, 1973) and potassium by Flame Photometer method (Toth and Prince, 1948). Nitrogen content of tuber was multiplied by factor 6.25 to get the crude protein. Ascorbic acid of potato tuber was estimated colorimetrically using 2-4 dinitro phenyl hydrazine method (Anonymous, 1990). Carbohydrates were determined as per anthrone method (Hodge and Hofreiter, 1962). The analysis ofvariance was worked out as per the procedure given by Gomezand Gomez (1984).

RESULTS AND DISCUSSION

Tuber Yield:

Potato tuber responded significantly with the increasing doses of nitrogen which may be attributed due to the greater synthesis and partioning of metabolites into economic parts. There was overall elasticity in sink with the higher levels of fertilizers. These finding are corroborations of the result of Boteva (2009).Application of FYM also increased the tuber yield of potato significantly as reported by. The increase in yield is due to more availability of essential nutrients to plants and improvement in physic- chemical properties of soil, resulting in better tuberization Khan *et al.(*2000). Combined application of N and FYM resulted in a significant interaction. Highest tuber yield was observed with the application of 180 kg N ha^{-1} and 24 t FYM ha^{-1}(Table 1).Integration of FYM and Inorganic Nitrogen exhibited an increase in tuber yield of potato. This could be due to balanced C/N ratio, more organic matter build up, enhanced microbial activity, improvement in soil properties, better root proliferation, sustainable availability and accelerated transport and higher concentration of plant nutrients. All these might have accelerated metabolical activities, leading to better photo syntheses and efficient translocation of photosynthates from sink to sources, resulting in improvement of leaf yield and its related attributes. The results are in line with the findings ofOuda and Mohadeen (2008).

Nutrient Content:

The nitrogen content in tubers increased significantly with the application of graded levels of N (Table 2).Increase in nitrogen content with inorganic nitrogen may be ascribed to the positive effect of chemical fertilizers on cell division, increased root hairs and root elongation of plant through which it may explore wider area for nutrient absorption leading to higher nutrient concentration in plant Devi *et al.* (1999). Nitrogen content in potato tuber also increased significantly with the application of FYM, as also reported by Brar*et al*. (2001).The findings of Nair *et al*. (1990) also revealed significant increase in nitrogen content and uptake with the application of FYM. Increased N contents of kale with FYM could be assigned to enhanced microbial population of N fixing micro-organisms due to available organic carbon as well as mineralization of organic nitrogen.Interaction between N and FYM on nitrogen content was significant.It may be inferred that, when organics are applied along

Table 1: Effect of nitrogen and FYM on potato tuber yield (t ha^{-1})

FYM levels (t ha^{-1})	Yield of potato tubers (t ha^{-1})				
	N_0	N_{60}	N_{120}	N_{180}	Mean
F_0	14.14	16.45	20.26	23.63	**18.622**
F_8	14.73	18.75	22.36	24.85	**20.17**
F_{16}	15.65	19.47	22.86	25.69	**20.92**
F_{24}	17.38	21.09	24.09	26.36	**22.23**
Mean	**15.48**	**18.94**	**22.39**	**25.13**	
CD(p≤0.05)		**Nitrogen (N)=0.17**		**FYM(F)=0.17**	**N x F=0.33**

with inorganic fertilizers to soil, complex nitrogenous compounds slowly break down and make steady N supply throughout the growth period of crop, which might have attributed to more availability of nutrients (Liu and Li 2003).

Application of nitrogen fertilizer increased the P content in tubers from 0.131 to 0.137%.This may be attributed to the synergistic interaction between nitrogen and phosphorus (Karitonas, 2003). Phosphorus content was also significantly increased with FYM application.The higher P content may be attributed to release of more native and applied P which in turn helps in more P absorption by the crop (Shashi*et al*. 1996). The interaction between FYM and N was significant in terms of P content. The highest P content was observed under combined application of N and FYM @ 180 kg ha^{-1} and 24 t FYM ha^{-1}.The increase in P content with application of FYM and inorganic fertilizer may be attributed to better availability of P in rhizosphere. The findings are in the accordance with the observation of Singh *et al*. (1982).

Increasing levels of N significantly increased the K content in tubers. Similar results have also been reported byChaurasia and Singh (1993).Concentration of K in potato tuber increased with applied FYM. Sud*et al*. (1992) suggested that the nutrient content depends upon the biological and physiological conditions existing at the root surface.The high phytase and nucleosidase activity provided at the rhizosphere by the addition oforganic manure resulted in better utilization of the nutrient by the crop, thus increasing its concentration and its uptake by the

Table 2: Effect of nitrogen and FYM on nutrient content of potato tubers

FYM Levels (t ha^{-1})	Nitrogen levels (kg ha^{-1})														
	N (%)					P (%)					K (%)				
	N_0	N_{60}	N_{120}	N_{180}	Mean	N_0	N_{60}	N_{120}	N_{180}	Mean	N_0	N_{60}	N_{120}	N_{180}	Mean
F_0	1.08	1.10	1.13	1.16	1.12	0.123	0.129	0.133	0.139	0.131	0.96	1.00	1.03	1.60	1.01
F_8	1.08	1.12	1.15	1.18	1.13	0.125	0.132	0.137	0.143	0.134	0.96	0.90	1.02	1.06	0.99
F_{16}	1.09	1.12	1.5	1.19	1.14	0.127	0.132	0.137	0.143	0.135	0.95	0.98	1.02	1.05	1.00
F_{24}	1.11	1.14	1.17	1.19	1.15	0.130	0.134	0.140	0.143	0.137	0.95	0.97	1.01	1.04	0.99
Mean	1.09	1.12	1.15	1.18		0.126	0.132	0.136	0.142		0.96	0.96	1.02	1.05	
C.D ($p \leq 0.05$) Nitrogen (N) = 0.005 FYM (F) = 0.005 N x F= 0.009						C.D ($p \leq 0.05$) Nitrogen (N) = 0.0007 FYM (F) = 0.0007 N x F= 0.0015					C.D ($p \leq 0.05$) Nitrogen (N) = 0.013 FYM (F) = 0.013 N x F= 0.009				

Table 3: Effect of nitrogen and FYM on quality parameters of potato tubers

FYM Levels (t ha-^{1})	Nitrogen levels (kg ha^{-1})														
	Carbohydrate (%)					Crude protein (%)					Ascorbic acid (mg $100g^{-1}$)				
	N_0	N_{60}	N_{120}	N_{180}	Mean	N_0	N_{60}	N_{120}	N_{180}	Mean	N_0	N_{60}	N_{120}	N_{180}	Mean
F_0	20.0	20.75	21.76	22.43	21.24	1.87	2.18	2.37	2.75	2.29	14.79	14.98	15.10	15.35	15.06
F_8	22.0	21.09	22.00	22.71	21.45	2.00	2.25	2.43	2.87	2.39	15.60	15.75	15.95	16.01	15.83
F_{16}	20.3	21.43	22.10	22.90	21.69	2.06	2.50	2.50	2.87	2.44	16.21	16.35	16.55	16.78	16.47
F_{24}	20.8	21.94	22.63	22.92	22.11	2.18	2.37	2.62	2.93	2.53	16.90	16.98	17.01	17.20	17.02
Mean	20.3	21.30	22.12	22.74		2.03	2.28	2.48	2.86		15.88	16.02	16.15	16.34	
C.D ($p \leq 0.05$) Nitrogen (N) = 0.15 FYM (F) = 0.15 N x F= 0.30						C.D ($p \leq 0.05$) Nitrogen (N) = 0.03 FYM (F) = 0.03 N x F= 0.07					C.D ($p \leq 0.05$) Nitrogen (N) = 0.06 FYM (F) = 0.06 N x F= 0.13				

plant. From Table 2 it is observed that the interaction of 180 kg N ha^{-1} with 24 t FYM ha^{-1} led to significantly higher K content in potato tuber.This might be the result of increasedavailability of K in the soil due to the application of organics. The results in agreement with the findings of Hangarge*et al.*(2002).

Quality Parameters:

Data presented in Table 3 indicated that carbohydrates, crude protein and ascorbic acid content in tubers increased significantly with increasing levels of nitrogen and highest was observed with the application of 180 kg N ha^{-1}*i.e*22.74%, 2.86% and 16.34 mg 100^{-1}g and lowest in control. These results are in conformity with the findings of Khan *et al*, (2000). Sud*et al*. (1992) found that increasing levels of nitrogen fertilizer recorded a significant increase in quality attributes in potato. This might be due to the reason that the plant supplied with nitrogen had higher K content, implying that these have absorbed more potassium which had play a better role in carbohydrate synthesis, starch break down, synthesis of proteins and neutralization of physiologically important organic acids results in higher quality tuber.

The levels of FYM had significant influence on carbohydrates, crude protein and ascorbic acid content in potato tubers; carbohydrate content increased from 21.24 to 22.11%, crude protein 2.29 to 2.53and ascorbic acid 15.06 to 17.02 34 mg 100^{-1}g with increase in FYM levels from 0 to 24 t ha^{-1}. 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 etc. The finding are in accordance with the observations of Mahmud *et al*. (2003) and Singh *et al*, (2008).

The highest carbohydrate (22.92%), crude protein (2.93) and ascorbic acid (17.20 34 mg 100^{-1}g) was obtained in treatment combination of $N_{180}F_{24}$ which was found superior over all other treatment combination. The increase in quality attributes might be due to the growth promoting substances secreted by farmyard manure in combination with nitrogen which could have accelerated synthesis of carbohydrates resulting in increased quality attributes in potato. The results are in conformity with the results of Kumar *et al*. (2006).

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