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Research Note

Effect of Applied Nutrients on the Starch, Proteins and Sugars in Potatoes

ABSTRACT

Applied nitrogen significantly decreased the starch, increased proteins but did not affect the sugar content of potato tubers. Phosphorus application did not affect the proteins or non-reducing sugars but significantly increased the starch and reducing sugar contents of potato tubers. Potassium application had a non-significant effect on these parameters. Application of nitrogen, phosphorus and potassium increased the yields of starch and proteins in potatoes.

INTRODUCTION

The nutritional composition of potato tubers plays a dominant role in determining the food value as well as the quality of the processed products (Lisinska & Sobkowicz, 1984; Lisinka & Leszczynski, in press). Mazza (1983) found that reducing sugars were significant in determining the chip colour of fresh and stored potatoes. The present investigation was undertaken to study the effect of different rates of nitrogen, phosphorus and potassium application on starch, protein and sugar contents and yields of potatoes.

MATERIALS AND METHODS

Three experiments were conducted during 1982–3 and 1983–4 on a sandy loam, moderately alkaline soil, to study the effect of nitrogen, phosphorus

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and potassium application on the starch, protein and sugar contents and search and protein yields of potatoes, var. 'Kufri Chandramukhi'. The available N, P and K contents of the soil for the different experiments was low in both years. In experiment 1, nitrogen was applied at the rates of 0, 50, 100, 150, 200 and 250 kg N ha^{-1}, alone and in combination with 30 tonnes ha^{-1} FYM (farmyard manure); in experiment 2, phosphorus was applied at the rates of 0, 30, 60, 90 and120 kg P_2O_5 ha^{-1}, alone and in combination with 30 tonnes ha^{-1} FYM; in experiment 3, potassium was applied at the rates of 0, 50, 100, 150 and 200 kg K_2O ha^{-1}, alone and in combination with 30 tonnes ha^{-1} FYM. The treatments were replicated four times in a randomized block design. Potato tuber samples were taken at harvest, processed, and N was determined by the method suggested by Warner & Jones (1970). Starch and sugars were determined by the method outlined by Hanes (1929) and crude proteins by multiplying the N content by 6·25. Yields of starch and proteins were estimated on the basis of their contents in potato tubers and the total dry matter produced.

RESULTS AND DISCUSSION

The effect of nitrogen, phosphorus and potassium application on the starch, protein and sugar contents of potato tubers is given in Table 1 and yield of starch and proteins in Table 2.

Applied nitrogen significantly decreased the starch content of tubers up to 100 kg N ha^{-1} and no significant change was observed at higher levels of its application. Application of nitrogen to the potato crop significantly enhanced the protein content of tubers, whereas no significant effect was found on the reducing or non-reducing sugars. Increase in the level of phosphorus application significantly increased the starch and reducing sugar contents of tubers but did not significantly affect the protein and non-reducing sugars. Application of potassium and FYM has no significant effects on any of the constituents studied. The decrease in starch content of tubers with increase in applied nitrogen may be attributed to the dilution effect as a result of an increase in the dry matter produced. Nitrogen application increased protein content of potato tubers, possibly because it is directly involved in the synthesis of amino acids, the constituents of proteins. Talley (1983) showed that protein and amino acid contents are proportional to nitrogen content and that nitrogen fertilization improved protein content of potatoes. Phosphorus application helped in increasing the starch and reducing sugar contents of tubers which may be attributed to the metabolic effect of P in translocation of starch and sugars to tubers. Similar results were reported by Fotyma & Grześkiewicz (1979) and Kamal *et al.* (1974).

TABLE 1

Effects of Nitrogen, Phosphorus and Potassium on the Starch, Crude Protein and Sugar Contents of Potato Tubers (Mean of two years)

Nutrient applied	*Dry basis*				*Fresh basis*			
	Starch (%)	*Proteins (%)*	*Reducing sugars (%)*	*Non-reducing sugars (%)*	*Starch (%)*	*Proteins (%)*	*Reducing sugars (%)*	*Non-reducing sugars (%)*
N (kg ha^{-1})								
0	75·0	11·2	2·30	0·97	16·0	2·40	0·49	0·20
50	73·8	11·3	2·30	0·97	15·7	2·42	0·49	0·19
100	71·6	11·8	2·35	0·96	15·2	2·51	0·50	0·20
150	71·1	11·7	2·34	0·90	15·0	2·50	0·49	0·18
200	70·4	11·9	2·40	0·94	14·9	2·52	0·51	0·19
250	70·6	12·0	2·39	0·87	14·7	2·50	0·50	0·18
CD (0·05)	0·9	0·21	NS	NS	0·3	0·07	NS	NS
P_2O_5 (kg ha^{-1})								
0	70·4	11·8	2·14	1·08	14·5	2·43	0·44	0·22
30	71·4	11·9	2·24	1·04	14·9	2·46	0·46	0·21
60	71·3	11·4	2·36	1·00	15·1	2·43	0·49	0·20
90	71·9	11·2	2·37	1·02	15·3	2·39	0·49	0·22
120	73·4	11·2	2·38	1·02	15·7	2·41	0·51	0·21
CD (0·05)	1·0	NS	0·06	NS	0·4	NS	0·02	NS
K_2O (kg ha^{-1})								
0	71·3	12·2	2·32	1·02	14·9	2·52	0·49	0·20
50	71·4	12·0	2·30	1·05	15·0	2·51	0·49	0·21
100	72·0	11·9	2·32	1·07	15·2	2·52	0·48	0·22
150	71·8	11·6	2·31	0·99	15·2	2·46	0·47	0·20
200	71·9	11·7	2·34	0·99	15·1	2·46	0·49	0·21
CD (0·05)	NS	NS	NS	NS	NS	NS	NS	NS

Significant increases in the starch and protein yields of potatoes were found up to the application of 200 kg N ha^{-1} in the absence and 250 kg N ha^{-1} in the presence of FYM which shows that response to nitrogen increased when it is applied along with FYM. The increase in yields of starch and proteins by potatoes were significant up to the application of 60 kg P_2O_5 ha^{-1} in the absence and 30 kg P_2O_5 ha^{-1} in the presence of FYM. In the case of potassium application, significant increases in starch and proteins were recorded up to 150 kg K_2O ha^{-1} in the absence and 100 kg K_2O ha^{-1} in the presence of FYM. This indicated that the response of potatoes to phosphorus and potassium decreased in the presence of FYM. The increases in the starch and protein contents of potatoes were found to be associated with the increase in the tuber dry matter yield as a result of applied nutrients. A significant positive correlation was observed

TABLE 2
Effect of Applied Nitrogen, Phosphorus and Potassium on the Yield of Starch and Proteins by Potatoes

N ($kg\,ha^{-1}$)	*Starch* ($kg\,ha^{-1}$)	*Proteins* ($kg\,ha^{-1}$)	P_2O_5 ($kg\,ha^{-1}$)	*Starch* ($kg\,ha^{-1}$)	*Proteins* ($kg\,ha^{-1}$)	K_2O ($kg\,ha^{-1}$)	*Starch* ($kg\,ha^{-1}$)	*Proteins* ($kg\,ha^{-1}$)
0	2085	318	0	2875	479	0	2605	443
50	3090	475	30	3944	649	50	3320	557
100	3575	588	60	4257	681	100	4234	701
150	3855	643	90	4325	683	150	4416	713
200	4100	691	120	4376	667	200	4460	725
250	4190	713						
CD (0·05)	175	32		178	39		161	43
FYM (*tonnes* ha^{-1})			*FYM* (*tonnes* ha^{-1})			*FYM* (*tonnes* ha^{-1})		
0	3148	510	0	3704	591	0	3610	598
30	3816	632	30	4206	674	30	4004	658
CD (0·05)	101	18		113	25		101	27

between tuber dry matter and starch yield ($r = 0{\cdot}97^{**}$, $0{\cdot}99^{**}$ and $0{\cdot}90^{**}$ for nitrogen, phosphorus and potassium, respectively).

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