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QUALITY OF TUBERS IN TAPIOCA (*MANIHOT UTILISSIMA* POHL) VAR "MALAYAN-4", AS INFLUENCED BY N, P, K AND Ca FERTILIZATION *

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Next to rice, tapioca is one of the important subsidiary food crops of Kerala. It is a rich source of carbohydrates and contains nearly 2.0 per cent, proteins, 0.4 per cent fats and 2.1 per cent mineral matter (Magoon and Appan, 1966). Apart from being a subsidiary food crop, it is now being used extensively as a raw material for the manufacture of high quality starch.

Not much work has been done on the quality of tapioca as influenced by mineral nutrition of the crop. In view of the fact that the crop is generally grown in the acid laterite, red loamy and sandy soils of Kerala, inherently poor in fertility, the present investigation was undertaken, to study the effect of three graded levels each of N, P, K and calcium, in a factorial experiment on the quality of tubers grown in this area.

Materials And Methods

Field experiments were conducted in the red loamy soils (total N 0.056 per cent, available P 0.002 per cent, available K 0.0007 per cent and PH 5.1) of the Agricultural College farm, Vellayani to study the quality of tubers as influenced by three graded levels each of nitrogen (50,100 and 150 kg N/ha), phosphorus (0,50 and 100 kg P_2O_5 ha), potash (100, 150 and 200 kg K_2O/ha) (0,600 and 1200 kg CaO/ha) in factorial combination. A 3^4 confoun experiment was laid out with 81 treatment combinations, with a single replication.

The entire dose of Ca was applied as per treatments soon after land preparation and demarcation of the plots. A uniform dose of farm yard manure at the rate of 6 t/ha was applied as basal dose along with phosphorus as per treatments. Nitrogen and potash were applied in two split doses, the first after 2 months and the second dose three months after planting, respectively, after each inter-cultivation. The fertilizers were applied in small basins formed around individual plant and were covered properly.

Stem cuttings (20-22 cm length) of tapioca variety "Malayan-4" was planted upright on the centre of the mounds raised at 90 cm apart after the basal

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application of manures. Uniform cultural practices such as weeding, inter-cultivation and earthing up were followed for all treatments. The crop was harvested 280 days after planting.

After recording the yield of tubers, the percentage of outer rind and edible fleshy portion of tubers, from individual plot were estimated on random samples. The dry matter content was estimated on known weight of chipped samples by sun-drying, followed by oven drying for constant weght and recording the dry matter content. The total N content of oven dried samples from individual plot was estimated by the Kjeldahl's method given by Piper (1948) and the crude protein content was computed. The percentage of starch contained in the oven dry samples from individual plot also was estimated by the A.O.A.C. method (1956).

Results And Discussion

The data on mean effects of individual nutrients on the quality of tapioca tubers are presented in table 1.

Table 1

Yield and quality of tubers in tapioca var. "Malayan-4" as influenced by graded levels of N, P, K and Ca in factorial combinations (Mean effects averaged over other treatments)

Treatments	Edible portion of tubers (%)	Dry matter (%)	Starch content (%)	Crude protein (%)	Yield of tubers (t/ha)
		On oven dry basis			
50 kg N/ha	85.3	33.4	77.5	1.93	30.99
100 kg N/ha	84.9	34.6	79.3	2.31	34.32
150 kg N/ha	84.1	34.7	80.8	2.36	35.50
'F' test	**	**	**		**
0 kg P_2O_5/ha	84.6	33.7	77.8	2.15	31.83
55 kg P_2O_5/ha	84.8	34.4	79.3	2.19	33.93
100 kg P_2O_5/ha	84.8	34.6	79.4	2.24	35.05
'F'	NS	**	**	**	**
100 kg K_2O/ha	84.1	32.9	77.2	2.22	32.63
150 kg K_2O/ha	84.9	34.8	79.5	2.24	33.72
200 kg K_2O/ha	85.2	35.0	79.9	2.13	34.46
test	**	**	**		*
0 kg CaO/ha	84.6	33.8	78.6	2.17	31.43
600 kg CaO/ha	84.0	34.3	78.9	2.20	34.32
1200 kg CaO/ha	84.9	34.5	79.1	2.22	35.06
'F' test	NS	*	NS	NS	**
C. D. (0.05)	0.4	0.5	0.5	0.06	1.35

The edible portion of tubers. Increasing the level of N from 50 to 150 kg per hectare, brought about a significant reduction in the weight of fleshy portion from 85.3 to 84.1 per cent; while raising the level of K fertillization from 100 to 200 kg K_2O/ha could increase the weight of edible portion significantly from 84.1 to 85.2 per cent. P and Ca fertilization had little effect on this character. This perhaps was due to the fact that N increased succulence, while K increased the weight of fleshy portion of the tubers. Similar findings were reported earlier from the Tapioca Research Station, Trivandrum (Anon, 1955). The fact that N increases succulence of plant parts is hardly a new observation and rind is no exception. Potash, in view of its role in carbohydrate metabolism and accumulation of more starchy foods in the fleshy portion of tubers might have naturally contributed for increased weight of the edible portion. This is an important consideration for determining the storage quality of tapioca.

Dry matter content. The individual effects of all the four nutrients as well as the combined effect of N and K had significantly increased the dry matter content of tubers. Application of N up to 100 kg, P_2O_5 up to 50 kg, K_2O up to 150 kg and CaO up to 600 kg/ha significantly increased the dry matter content, as compared to the next lower levels of their application; although beyond these levels there was no significant increase in dry matter content. Malavolta ef *al.* (1955) and Cours ef *al.* (1961) also recorded similar observations and the trend could be explained in terms of more dry matter production and starch accumulation as influenced by adequate N P K nutrition.

Starch content. Application of incremental doses of N, P and K contributed for increased starch content of tubers. Application of 1200 kg per hectare of CaO also had a significant effect on starch content although the effect was not significant at lower levels. The trend of these results could be substantiated by the findings of Moursi and Toval (1957) in cams of "Egyptian colacasia", where the distribution of starch followed that of dry matter. The presence of N is essential for increased photosynthetic rate. P and K, on the other hand, help in the conversion of photosynthates to carbohydrates and starch, thereby increasing the dry matter production as well as starch content. De (1960) reported increased starch content of potato with increasing levels of K fertilization. Starch content is an important consideration in determining the industrial value of tuber for the manufacture of starch.

Crude protein content. Among all the nutrient elements, N had a very significant effect in increasing the protein content of tubers. Application of 100 kg N/ha increased the protein content to 2.31 per cent (on oven dry basis), as compared to 1.93 per cent at 50 kg N per hectare. Application of 100 kg P_2O_5/ha also had a favourable effect on the protein content. K had a depresssing effect on protein content of tubers; while the effect of Ca was not very pronounced. This could be explained only in terms of the inter-relationship between

carbohydrate and protein metabolism in the plant. Nitrogen in the plant is present mostly in the form of proteins and hence the observed trend in crude protein content, with increasing levels of N application. Application of K, on the other hand, might have contributed more towards starch production as observed in the present study. These results are also in agreement with the earlier reports from the Tapioca Research Station, Trivandrum (Anon, 1960). Agronomical manipulation of protein content in tapioca is of great significance, as it happens to be an important subsidiary food for millions of people, whose protein intake is generally low.

Summary

Field experiments and quality studies on tapioca variety "Malayan-4" study the effect of three graded levels each of nitrogen (50, 100 and 150 kg N per hectare), phosphorus (0, 50 and 100 kg P_2O_5 per hectare), potash (100, 150 and 200 kg K_2O per hectare) in conjunction with calcium (0, 600 and 1200 kg CaO per hectare) on the quality of tapioca tuber grown in the red loam soils of Agricultural College farm at Vellayani, Trivandrum have shown that application of higher levels of N beyond 100 kg/ha decreased the weight of edible fleshy portion of tubers, though it increased the protein content, dry matter as well as the starch content. Application of K increased the weight of edible portion, dry matter as well as starch content of tubers, though its application beyond 150 kg K_2O/ha reduced the protein content. Application of moderate levels of 50 kg P_2O_5 and 600 kg CaO/ha also had some favourable influence on starch content, though they had very little effect on the protein content, as well as weight of edible fleshy portion of the tubers.

സംഗ്രഹം

മരച്ചീനിക്കിഴങ്ങുകളും ഞണക്കുവേരുകളും കിട്ടുന്ന തൂക്കം, അന്നജാംശം, മാംസ്യാംശം എന്നീ ഗുണങ്ങളും പാകൃജനകവും, ഭാവഹവും, ക്ഷാരാംശവും കുമ്മായവും അടങ്ങിയ രാസവളങ്ങളും ചില അളവിലും തൂക്കത്തിലും ചേർത്തു വളർത്തുമ്പോഴും ഏതെല്ലാം rairaarinlKrJ ബാധിയ്ക്കുന്ന എന്നറിയുന്നതിലേക്കായി, വെള്ളായണി കാർഷികffi(&>3Gg?3° ഫാമത്തിലേ ചുവന്ന ലോം മണ്ണിൽ "മലയൻ–4" എന്നയിനം fflaxajlrnlcffiVja നടത്തിയ പരീക്ഷണ നിരീക്ഷണങ്ങളിൽ നിന്നും reno ഴെപ്പായുന്ന വിവരങ്ങളും ലഭിച്ചിരിയ്ക്കുന്നു.

പാകൃജനക പ്രധാനമായ വളങ്ങളും പൊതുവേ കിഴങ്ങിന്റെ പുറം തോടിന്റെ തൂക്കവും, ജലാംശവും വർദ്ധിപ്പിയ്ക്കുന്നതുവഴി മാംസളാംശത്തിന്റെ തൂക്കം ചെറിയ തോതിലെങ്കിലും കുറയ്ക്കുന്നുണ്ടെങ്കിലും, കിഴങ്ങിന്റെ മാംസ്യാംശവും, അന്നജാംശവും ഇതുമൂലം ഗണ്യമായി കൂട്ടുന്നതായിട്ടാണ് കണ്ടത്. മറിച്ച് ക്ഷാരാംശ പ്രധാനമായ വളങ്ങളും കിഴങ്ങിന്റെ മാംസള ഭാഗത്തിന്റെ പച്ചയ്ക്കും, ഉണങ്ങിക്കഴിഞ്ഞതുമുള്ള തൂക്കത്തേയും അന്നജാംശത്തേയും വർദ്ധിപ്പിച്ചെങ്കിലും, തന്മൂലം മാംസ്യാംശത്തെ കുറയ്ക്കുന്നതായിക്കണ്ടു. എന്നാൽ ഭാവഹത്തിനും, കുമ്മായത്തിനും കിഴങ്ങുകളുടെ അന്നജാംശം വർദ്ധിപ്പിയ്ക്കുന്നതിൽ മാത്രമെ എന്തെങ്കിലും പങ്ക് ഉള്ളതായി തോന്നിയുള്ളൂ.

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