



ANIYOOR



7-111-E3-5



Tuber of W-19



Tuber of CR 43-8



NUTRIENT USE EFFICIENT (NUE) GENOTYPES IN CASSAVA CAN REDUCE CHEMICAL FERTILIZER USE

Among the tropical tuber crops, cassava popularly known as 'Tapioca' is important for Keralites as the subsidiary food after rice. The 'poor man's food', as known during nineties is a rich man's food now and is a delicious item in many five star hotels. However, this is still valued greatly by the farmers as the best energy source

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SREE PAVITHRA



7-111-E 3-5



CI - 905



CI - 906

and is taken along with fish as better and cheap 'value added carbohydrate' to sustain health of the farming community.

Cassava was brought to Kerala by His Highness VisakhamThirunal Maharaja during the days of famine during and after the Second World War. Owing to its high energy/ starch content it could compensate the shortage of rice during that time. Though the inherent biochemical attributes of the crop was not known at that time, later researches revealed the energy in tapioca is same as that of rice (121 mega joules/ ha/day). Moreover, they possess many very important properties like presence of beta carotene in yellow fleshed tubers, high fibre content, low fat, presence of amino acids like arginine and minerals like P, Ca, Fe and high K:Na ratio, which in turn, are important for the health wellness in the present day life. In addition, the leaves are rich in minerals, proteins, vitamins though they are poor in energy.

As we know, compared to field crops like rice, wheat and pulses, the productivity of these crops are very high to the tune of more than five times that of field crops. This high productivity definitely underscores the quantum of nutrients they take up from the soil so as to produce this much yield. In other words, in order to sustain the productivity, replenishment of the absorbed nutrient is a must in tuber crops cultivation. The long term fertilizer experiment (LTFE) at ICAR-CTCRI since 1977, clearly indicates integrated nutrient management (INM) practices

involving balanced use of organic manures, chemical fertilizers and biofertilizers is the best in this regard. The organic manure commonly recommended is farm yard manure (FYM) @12.5 t/ha and the LTFE indicated, FYM can be substituted by green manuring in situ with cowpea, coir pith compost, vermicompost or the residue of the crop itself.

The recommended package of practices (PoP) for cassava is NPK @100:50:100 kg/ha and now we are recommending the application of N,P,K based on soil test. Since 90% of the soils of Kerala are high in available P, either the application of P can be avoided or can be reduced to a maintenance dose of 25% of P recommendation as per PoP. Under INM, while using bio fertilizers, the recommended dose of N, P, K can be reduced by using NUE bio fertilizers like N fixers, P and K solubilizers.

Coming to the subject of NUE cultivars in a very simplified way, because of the particular root system or leaf architecture, they can harness more of nutrients to plants thereby the dependence on external application of fertilizers can be reduced. As regards to the root system, the presence of more number of water and nutrient absorbing white roots in NUE genotypes can actively mobilize the fixed unavailable soil nutrients making them available for plant uptake. Similarly the high leaf area index (LAI) either through higher leaf size, more number of leaves or better leaf retention can cause more assimilation

Table 1: Tuber yield of NPK use efficient genotypes under onfarm trial (I season)

Districts	kg/plant				District
	SreePavithra	CI-905	CI-906	7III E3-5	Mean
Kollam	8.2	6.8	7.3	7.9	7.55
Kottayam	8.1	6.8	7.9	3.5	6.58
Kannur	6.8	7.9	8.9	9.1	8.18
Kozhikkode	9.1	8.9	6.8	9.1	8.48
Ernakulam	6.7	5.6	8.1	5.8	6.55
Pathanamthitta	5.6	6.8	7.9	5.7	6.50
Genotypes (Average)	7.42	7.13	7.82	6.85	7.31

Table 2: Tuber yield of NPK use efficient genotypes under on farm trial (II season)

Districts	SreePavithra	CI-905	7III E3-5	Local variety	District Mean
Kollam	8.17	5.97	9.92	5.54	10.53
Kottayam	9.2	10.5	8.6	5.2	8.34
Kozhikkode	3.5	-	-	2.9	3.2
Thiruvananthapuram	4.5	4.0	3.6	3.1	3.8
Genotypes (Mean)	7.6	7.87	8.27	3.66	

of photosynthates thereby the plant growth and incidentally the partitioning of dry matter for tuber growth and development can be improved. Since all these are ultimately resulting in reduction in the application of chemical fertilizers from outside, there is scope to use these cultivars as planting materials in organic farming which is being presently promoted in Kerala.

At ICAR-CTCRI, we have initiated research in this line since 2007 to identify K efficient cassava genotypes followed by N efficient and NPK efficient. As a prelude to screening K efficient genotypes, a total of 83 elite genotypes from cassava germplasm available with ICAR-CTCRI was evaluated for many traits specifically the inherent nutrient use efficiency of a crop known by the term 'physiological efficiency' by growing these genotypes in a row trial with ten plants each in a row without the application of any manures and fertilizers. In addition, other attributes like tuber yield,

tuber quality parameters like cooking quality, content of starch, cyanogenic glucosides (responsible for bitterness), plant stature, tolerance to cassava mosaic disease (CMD), sprouting percentage were evaluated. From these 83 genotypes, after taking into account all these factors, 6 genotypes (Aniyoor, 7 III E3-5, W-19, CR 43-8, 6-6, SreeSahya) were selected and were tested under four levels of K viz., 0, 50, 100, 150 kg/ha for three years consecutively in a split plot design. As the growth and yield of SreeSahya was not up to the expectation during the first year, it was replaced by H1687 (SreeVisakham), a variety released from this Institute as a check.

Under the experiment on identification of K efficient variety, the mean tuber yield data of the three years at 0, 50, 100, 150 kg/ha was 31, 36, 40, 36 t/ha and there was no significant difference between 0 and 50 kg/ha and 50 and 100 kg/ha indicating that this variety for

an average yield can be grown without applying K and for getting high yield K @50 kg/ha can be applied. This in turn showed that by using K efficient genotypes, the application of K can be either skipped or reduced to 50% of the recommended dose. Among these genotypes, considering physiological efficiency and other attributes indicated above CR 43-8, followed by 7 III E3-5 and SreePavithra was found best recording yields the tune of 40.572, 38.388 and 35.828 t ha⁻¹ respectively. On scientifically analysing the reasons as indicated above like root and leaf architecture, it is understood that, these genotypes have more number of white roots as well as high LAI compared to check.

In the preceding two years, on farm trials were carried out for two seasons in farmers' fields under the supervision of KVK's to study the farmers response. During the first season, the trials were conducted by Thiruvananthapuram and

Pathanamthitta KVK's in five farmers' fields.

The average yield of genotypes viz., H1687, Aniyoor, 7III E-3-5, CR 43-8 and W-19 were 3.30, 4.55, 3.67, 3.56, 3.59 kg/plant with K @ 50 kg/ha where the yield recorded under the local variety was 3.51 kg/plant under normal PoP(K@ 100 kg/ha). Again in the second season also trials were conducted in farmers' fields and the average yield obtained by a farmer at Anchal in Kollam district was 5.65, 10.45, 10.65, 8.80, 3.75 kg/plant respectively for the above genotypes. Apart from tuber yield, after taking into account, all other traits as described above, Aniyoor was found as the best farmer acceptable cultivar and was released for Kerala state during 2015 in the name 'SreePavithra'.

In the next three years, we have done trials to see the N efficiency potential of K efficient genotypes by conducting field experiments with N @ 0, 50, 100 and 150 kg/ha. The tuber yield under the above N rates was 26.063, 28.023, 32.721, 33.284 t/ha respectively, indicating no significant yield difference between 0, 50 and between 50 and 100 kg/ha suggesting that while using these lines, the N application rate can be reduced to 50 kg/ha. Among these six genotypes, genotypes viz., W-19 and CR 43-8 was found the highest yielders to the tune of 33.12, 34.68 t/ha. Though the tuber yield was better, the other attributes as indicated with respect to plant stature and tuber quality appears to be not that satisfactory, and hence they were not given for

on farm trial. But was kept apart for registration as N efficient cassava genotypes and as a resource for breeding N efficient cassava varieties in future.

During these years itself, we were in the process of evaluating another set of genotypes of the germplasm for NUE by conducting a preliminary evaluation with 300 elite genotypes as we did for screening K efficient genotypes. Here, we have identified 16 genotypes which were classified based on their innate physiological efficiency of N,P, K and those with high N,P, K efficiency were selected and tested for their NPK use efficiency by laying out field trials for three years at four (25,50, 75, 100kg/ha) levels of NPK as per PoP. The genotypes used were SreePavithra, CI-905, CI-906 and 7III E3-5. During all these years, no significant effect of levels of fertilizers was seen on tuber yield. Otherwise, the tuber yield recorded with the four levels were the same indicating that by using these genotypes, the NPK application rate can be reduced to 25% of PoP. The mean tuber yield of these three years at 25,50,75 and 100kg/ha was 32.032, 33.024, 34.292 and 36.174 t/ha respectively and the mean yield of these genotypes viz., SreePavithra, 7III E3-5, CI-905 and CI-906 were 32.887, 38.479, 36.458, 30.979 t/ha respectively. The cyanogenic glucoside content was 36.43, 60.17, 63.20, 75.93 ppm and starch content was 19.69, 20.20, 17.99, 21.90% respectively.

For testing the acceptability of these cultivars, they were given for on farm trials for two seasons. During the first

season, it was tried by 24 farmers in six districts of Kerala with 25% NPK of PoP. The mean tuber yield from the districts are presented in Table 1. Though CI-906 gave the highest yield, after considering all other associated traits as indicated earlier, the order of preference was SreePavithra, 7 III E3-5, CI-905, CI-906.

Again in the last year (2019-20), it was again tested for the second season through KVK's of Thiruvananthapuram, Kottayam, Kollam and Calicut through farmers on farm trials with an NPK recommendation of 25% of PoP. The tuber yield obtained from these trials is presented in Table 2.

Local varieties in each district was given NPK at the recommended dose and the district average is the average yield from 5-10 trials in each district. In two farmers' fields of Kollam and Kottayam, one tuber of Sreepavithra weighed more than 5 kg.

Tubers of SreePavithra having more than 5kg weight

Among these genotypes, tubers of CI-905 possessed dark yellow colour due to the presence of sufficient beta carotene in the tubers.

Moreover, all these genotypes were tolerant to CMD also. However, these genotypes were not yet released as they are not inherently mosaic resistant. If interested farmers are there to cultivate these genotypes on experimental basis, they can contact either the Institute Farm (Contact No. 0471-2598551 Extn. 306) or the concerned scientist (Dr. Susan John K, Mob. No. 9446324298) so that the planting materials can be made available.