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Quality Characters of Tannia [*Xanthosoma sagittifolium* (L.). Schott] as Affected by Tillage, Planting Methods, Plant Nutrition and Application of Soil Conditioners

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ABSTRACT

Background: Tannia is one of the six most important root and tuber crops grown world-wide. Tannia possess good keeping quality compared to other vegetables. The tubers are considered more nutritious than colocasia and potato. But the crop is still under-exploited compared to other tuber crops. Hence the study was undertaken to identify the effect of tillage and nutrition on quality characters of tannia.

Methods: A field experiment was conducted at College of Agriculture, Vellayani, Kerala during 2014-15 to study the effect of organic nutrition on quality characters of tannia. The design used was split plot design with four replications. The treatments consisted of tillage and planting methods as main plot treatments (L_1- conventional tillage followed by pit system, L_2- conventional tillage followed by mound system, L_3- deep tillage followed by pit system and L_4- deep tillage followed by mound system). The sub plot treatments were combinations of soil conditioners (S_1- control, S_2- coir pith, S_3- rice husk) and two nutrition systems (N_1- integrated nutrient management (INM) and N_2- organic nutrition).

Result: Results of the experiment revealed that the quality characters of tannia was improved by deep tillage to a depth of 30 cm followed by pit system of planting, application of coir pith as soil conditioner @ 500 g plant^{-1} and organic nutrition (FYM @37.5 t ha^{-1} + wood ash @ 2 t ha^{-1}).

Key words: Organic nutrition, Quality, Starch, Tannia, Tillage.

INTRODUCTION

Tannia [*Xanthosoma sagittifolium* (L.). Schott] believed to be one of the earliest cultivated tuber crops in the world, belonging to the family Araceae. According to Onwueme and Charles (1994) tannia is one of the six most important root and tuber crops grown world-wide. They are grown in field conditions year round, in tropics. The corm, cormels and leaves of tannia are prime source of carbohydrates, vitamins and minerals and hence is consumed by humans and is also used as animal feed (Nyochembeng and Garton, 1998). The tubers are considered more nutritious than colocasia and potato (John *et al*., 2006). Pushpakumari and Sasidhar (1996) and Ramesh *et al*. (2007) observed that tannia is one of the most shade tolerant food crops and hence suited for intercropping and mixed cropping systems. The plants produce large amount of foliage in the first six-seven months and produce up to ten cormels in ten months. Higher variation in yield has been observed when it is grown in different soil types. In Kerala, tannia is grown in the homesteads and in the coconut gardens in uplands and along with Nendran banana in lowlands. The tubers when used as vegetable possess good keeping quality compared to other vegetables. But the crop remains under-exploited when compared to other tuber crops. Hence, the present study was undertaken to identify the effect of tillage and nutrition on quality characters of tannia.

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MATERIALS AND METHODS

The field experiment was conducted at the Instructional farm attached to College of Agriculture, Vellayani, Thiruvananthapuram, Kerala during 2014-15. Vellayani experiences warm, humid tropical climate. The soil of the experimental site was sandy clay loam with a pH of 5.7. The soil was high in organic carbon and available P, low in available N and medium in available K. The experiment was laid out in split plot design with tillage and planting systems as four main plot treatments (L_1- Conventional tillage followed by pit system, L_2- Conventional tillage followed by mound system, L_3- Deep tillage followed by pit system and

L_4 - Deep tillage followed by mound system). The sub plot treatments were combination of three soil conditioners (S_1- Control, S_2- Coir pith, S_3- Rice husk) and two nutrient management systems (N_1- Integrated nutrient management (INM) and N_2- Organic nutrition). The soil conditioners were incorporated in soil @ 500 g per plant. The integrated management system involved application of farmyard manure (FYM) @ 25 t ha^{-1} + 80:50:150 kg NPK ha^{-1}. Half the quantity of FYM and full dose of P were applied as basal dose and half the quantity of FYM along with N and K were given in three split doses each at 2, 4 and 6 months after planting (MAP). Organic nutrition comprised of FYM @ 37.5 t ha^{-1} + wood ash @ 2 t ha^{-1} out of which two-third quantity of FYM was applied as basal dose and remaining quantity of FYM and wood ash were given in three split doses at 2, 4 and 6 months after planting. Dolomite @ 1 t ha^{-1} was applied uniformly to all plots during land preparation.

The land was prepared as per the treatments and corm pieces weighing about 80g, ensuring atleast one sprout, were used for planting. The crop was planted during August 2014 at a spacing of 0.75 m × 0.75 m and was mulched with green leaves immediately after planting. Interculture operations and earthing up were done along with top dressing at 2, 4 and 6 months after planting. The crop was ready for the harvest by May 2015.

The dry matter production was recorded at the harvest. The sample plants uprooted were separated into blade and petiole (leaf or pseudo stem), corm and cormels. Fresh weight of each part was recorded and sub samples were taken for estimating the dry weight. The sub samples were dried in a hot air oven at 65±5°C to constant dry weight. The dry weight of each part was worked out and total dry matter production (TDMP) was computed in terms of t ha^{-1}. Harvest index was also worked out from the observational plants. Harvest index is the ratio of cormel yield to total biomass on dry weight basis (Suja *et al*., 2009). Starch content of cormel was estimated by using potassium ferri cyanide method (Ward and Pigman, 1970). The values were expressed as percentage on dry weight basis. Protein content (%) of cormel on dry weight basis was calculated by multiplying N content (%) in cormel with the factor 6.25 (Simpson *et al*., 1965). Samples of cormels weighing 100 g each taken from each treatment were spread on floor over newspaper under ambient conditions and observed for shelf life. The cormels were observed daily for sprouting and decay. The weight of samples was recorded once in three days to calculate physiological loss in weight (PLW) using the formula as given below.

$$\text{PLW}(\%) = \frac{\text{Initial weight - Final weight}}{\text{Initial weight}} \times 100$$

Table 1: Effect of tillage systems, soil conditioners and nutrient management on total dry matter production (TDMP) and harvest index.

Treatments	TDMP (t ha^{-1})	Harvest index
Tillage systems (L)		
L_1- Conventional tillage- pit system	3.39	0.31
L_2- Conventional tillage-mound system	3.08	0.29
L_3- Deep tillage-pit system	4.36	0.32
L_4 - Deep tillage-mound system	3.71	0.31
SEm±	0.030	0.005
CD (0.05)	0.110	0.018
Contrast analysis- Conventional vs Deep tillage		
Conventional tillage	3.24	0.30
Deep tillage	4.04	0.32
F test	S	S
Contrast analysis – Pit vs Mound system of planting		
Pit system	3.87	0.32
Mound system	3.40	0.30
F test	S	S
Soil conditioners (S)		
S_1- Control	3.30	0.30
S_2- Coir pith	3.95	0.32
S_3- Rice husk	3.66	0.31
SEm±	0.036	0.004
CD (0.05)	0.103	0.011
Nutrient management (N)		
N_1- INM	3.37	0.29
N_2- Organic nutrition	3.90	0.32
SEm±	0.030	0.003
CD (0.05)	0.084	0.009

S- Significant.

RESULTS AND DISCUSSION

Total dry matter production

A perusal of the data on Table 1 revealed significant effects of treatments on total dry matter production (TDMP). Among tillage systems, deep tillage and pit system (L_3) registered significantly higher dry matter production (4.36 t ha^{-1}) followed by deep tillage and mound system (L_4). Deep tillage registered significantly higher TDMP over conventional tillage. Pit system registered superior TDMP over mound system as revealed from contrast analysis. Larger sized leaves were produced due to deep tillage followed by pit system and this might have led to improved production of assimilates resulting in higher dry matter production. Not only dry matter production, but its partitioning to the economic part, especially cormel was also favourably influenced by deep tillage and pit system of planting. Application of soil conditioner recorded significantly higher TDMP over control (S_1). Coir pith (S_2) was superior (3.95 t ha^{-1}) to rice husk (S_3) as soil conditioner. After the investigation, organic nutrition (N_2) proved its superiority in its effect on TDMP (3.90 t ha^{-1}) over INM (N_1). Suja *et al*. (2009) also reported that organic nutrition favoured effective partitioning of assimilates to cormels resulting in higher tuber yield of tannia.

Harvest index

Deep tillage followed by pit method (L_3), deep tillage followed by mound method (L_4) and conventional tillage followed by pit method (L_1) of planting were found at par in their effects on harvest index. The application of soil conditioner significantly increased the harvest index and the effects of coir pith (S_2) and rice husk (S_3) were found on a par. Organic nutrition (N_2) registered the higher harvest index compared to INM (N_1).

Dry matter content of the cormel

Various tillage systems, soil conditioners and nutrient management had significant influence on dry matter content of cormel (Table 2). Deep tillage and pit system (L_3) registered significantly higher (31.9%) dry matter content of cormel followed by deep tillage and mound system (L_4). The superiority of deep tillage over conventional tillage and pit over mound system of planting was revealed from contrast analysis. Application of soil conditioner resulted in significantly higher content of dry matter in cormel and coir pith (S_2) was found superior (31.55%) to rice husk (S_3) as soil conditioner during period of study. Organic nutrition (N_2) resulted in significantly higher dry matter content (31.91%) of cormel than INM (N_1).

Table 2: Effect of tillage systems, soil conditioners and nutrient management on quality characters of cormel.

Treatments	Cormel dry matter content(%)	Starch content(%)	Protein(%)
Tillage systems (L)			
L_1- Conventional tillage- pit system	29.68	61.32	6.86
L_2- Conventional tillage-mound system	28.25	57.78	6.53
L_3- Deep tillage-pit system	31.90	66.05	7.26
L_4 - Deep tillage-mound system	30.22	65.57	7.00
SEm±	0.272	0.136	0.043
CD (0.05)	1.007	0.503	0.160
Contrast analysis- Conventional vs Deep tillage			
Conventional tillage	28.96	59.55	6.70
Deep tillage	31.06	65.81	7.13
F test	S	S	S
Contrast analysis – Pit vs Mound system of planting			
Pit system	30.79	63.68	7.06
Mound system	29.24	61.68	6.77
F test	S	S	S
Soil conditioners (S)			
S_1- Control	28.56	61.44	6.48
S_2- Coir pith	31.55	64.04	7.14
S_3- Rice husk	29.92	62.56	7.11
SEm±	0.246	0.117	0.065
CD (0.05)	0.695	0.331	0.184
Nutrient management (N)			
N_1- INM	28.11	61.97	6.73
N_2- Organic nutrition	31.91	63.39	7.09
SEm±	0.201	0.095	0.053
CD (0.05)	0.568	0.270	0.150

S- Significant.

Table 3: Effect of tillage systems, soil conditioners and nutrient management on physiological loss in weight of cormel after 45 days of storage.

Treatments	Physiological loss in weight (%)
Tillage systems (L)	
L_1- Conventional tillage- pit system	15.31
L_2- Conventional tillage-mound system	16.16
L_3- Deep tillage-pit system	12.71
L_4 - Deep tillage-mound system	13.41
SEm±	0.035
CD (0.05)	0.130
Contrast analysis- Conventional vs Deep tillage	
Conventional tillage	15.74
Deep tillage	13.06
F test	S
Contrast analysis – Pit vs Mound system of planting	
Pit system	14.01
Mound system	14.78
F test	S
Soil conditioners (S)	
S_1- Control	14.09
S_2- Coir pith	14.63
S_3- Rice husk	14.47
SEm±	0.037
CD (0.05)	0.104
Nutrient management (N)	
N_1- INM	14.59
N_2- Organic nutrition	14.21
SEm±	0.030
CD (0.05)	0.085

S- Significant.

Starch content of the cormel

The main effects of treatments were found to be significant (Table 2). Deep tillage followed by pit system (L_3) registered the highest content of starch (66.05 per cent) in cormel but was at par with deep tillage followed by mound system (L_4). Contrast analysis indicated the significance of deep tillage over conventional tillage and pit system of planting over mound system. Coir pith as soil conditioner (S_2) registered significantly higher starch content (64.04%) than control (S_1) and rice husk (S_3). Organic nutrition (N_2) recorded significantly higher starch content (63.39%) during the period of study. According to Suja *et al*. (2010; 2012a; 2012b), Suja (2013) and Kolambe *et al*. (2013), there is improvement in tuber quality of elephant foot yam due to organic nutrition. Similar results were also reported in yams by Suja (2013) and Kaswala *et al*. (2013).

Protein content

As presented in Table 2, the main effects of treatments on protein content of cormel were significant. Deep tillage followed by pit system (L_3) produced significantly higher protein content (7.26%). Contrast analysis revealed the superiority of deep tillage over conventional tillage and pit system over mound system of planting. Coir pith (S_2) was superior to rice husk (S_3) as soil conditioner and control (S_1) in its effect on protein content. As in the case of dry matter and starch contents, organic nutrition (N_2) resulted in significantly higher content of protein in the cormel during the period of study (7.09 %) compared to INM (N_1).

Shelf life

When cormels were arranged on news paper on floor under ambient conditions, no decay of cormel was observed upto 45 days of storage. Sprouting of cormels started from 32nd day. About 50 per cent sprouting was observed on 46th day when observations on shelf life were determined. Archana (2001) also reported 50 per cent sprouting of tubers in the stored samples of coleus within 30 to 40 days of storage irrespective of the treatments. Jayapal *et al*. (2015) also found that sprouting of coleus started after one month of storage and was completed by two months irrespective of treatments. The data on physiological loss in weight (PLW) of cormel after 45 days of storage is given in Table 3. Tillage systems differed significantly in registering physiological loss in weight (PLW) of cormel during storage (Table 3). The PLW was minimum (12.71%) after 45 days of storage with deep tillage followed by pit system of planting (L_3) and maximum with conventional tillage followed by mound system (L_2). The superiority of deep tillage over conventional tillage and pit system over mound system of planting was evident from contrast analysis also. The cormels from plots without soil conditioner (S_1) recorded minimum (14.09%) PLW after 45 days of storage (Table 3). The plots with organic nutrition (N_2) produced cormels which recorded lower values of PLW after 45 days of storage compared to INM (N_1). This is in confirmation with the studies of Kumar *et al*. (2011) who also observed highest percentage of PLW when the crop received inorganic fertilizers alone.

CONCLUSION

Deep tillage followed by pit system profoundly improved the total dry matter production and harvest index. The use of a soil conditioner markedly improved the TDMP. Coir pith as soil conditioner markedly improved the TDMP. Harvest index can be increased by using coir pith or rice husk as soil conditioner. Organic nutrition dominated over INM in its effects on TDMP and harvest index. Deep tillage followed by pit system combined with coir pith or rice husk as soil conditioner under organic nutrition resulted in higher dry matter production and harvest index.

The quality characters like dry matter, starch and protein contents of cormel were improved by deep tillage followed by pit system along with the application of coir pith as the soil conditioner. Organic nutrition was found superior to INM in influencing quality characters. The present study revealed that cormels of tannia could be stored for one month without any microbial decay, sprouting and appreciable PLW. No decay due to microbial attack was observed upto 45 days of storage under ambient conditions.

To conclude, the quality characters of tannia can be improved widely by deep tillage to a depth of 30 cm followed by pit system of planting, application of coir pith as soil conditioner @ 500g plant^{-1} and organic nutrition (FYM @ 37.5 t ha^{-1} + wood ash @ 2 t ha^{-1}).

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