Potential of Tannia (Xanthosoma sagittifolium (L.) Schott.) for Organic Production

3 authors, including:

Girija Suja
Central Tuber Crops Research Institute (under Indian Council of Agricultural Rese…
59 PUBLICATIONS **435** CITATIONS

SEE PROFILE

Susan JOHN Kuzhivilayil
ICAR-Central Tuber Crops Research Institute
59 PUBLICATIONS **335** CITATIONS

SEE PROFILE

Journal of Root Crops, 2009, Vol. 35 No. 1, pp. 36-40
Indian Society for Root Crops
ISSN 0378-2409

Potential of Tannia (*Xanthosoma sagittifolium* (L.) Schott.) for Organic Production

G. Suja, K. Susan John and S. Sundaresan

Central Tuber Crops Research Institute, Sreekariyam, Thiruvananthapuram, Kerala, India

Corresponding author: G.Suja, e-mail: sujagin@yahoo.com

Abstract

Information on organic production of tannia is meagre. Two separate field experiments were conducted at Central Tuber Crops Research Institute, Sreekariyam, Thiruvananthapuram during 2003-2005 to evaluate the growth and yield response of tannia to organic management. The results clearly indicated that tannia is more adapted to organic cultivation and has great potential for organic production. In the first experiment, among the various nutrient management practices, application of FYM @ 12.5 t ha^{-1} and ash @ 3 t ha^{-1} favoured plant height, leaf production, number of cormels, cormel yield, mother corm yield and dry biomass yield of corms and cormels. In the subsequent experiment, organic farming involving use of organic manures viz., farmyard manure @ 20 t ha^{-1}, green manuring with cowpea to generate 15-20 t ha^{-1} of green matter in 45-60 days, neem cake @ 1 t ha^{-1} and ash @ 2 t ha^{-1} produced significantly higher cormel yield (11.25 t ha^{-1}) and mother corm yield (22.96 t ha^{-1}).

Introduction

Tannia, also known as new cocoyam, is an important tuberous vegetable cultivated for its edible tubers and tender leaves. The starchy tubers occupy an important place in the diet of people in many tropical countries. The main corms (mother corm) are very acrid and so only the cormels (side corms) are eaten. The subterranean cormels, used as high-energy food, contains 17-26 % carbohydrate, 1.3-3.7% protein and 65-77% water and have nutritional value comparable to potato (Onwueme and Charles, 1994; Agueguia, 2000). A secondary use is the consumption of young, tender leaves, with protein content of 22.17 g per 100g, similar to spinach (Liefstingh, 1963; Karikari, 1971; Cobley and Steele, 1976). The carbohydrate present in tubers is of mostly starch. The starch has relatively large grains with average diameter of 17-20 μm (Onwueme, 1978). Industrially, the cormels are used for production of starch (Shiraishi et al., 1995, Lauzon et al., 1995) and foliage as poultry feed. The corms are used as human food or animal feed after cooking, besides as planting material. Minute bundles of calcium oxalate crystals present in the corms have an irritating effect, which get leached out in water during boiling (Agueguia, 2000). In some places flesh scrapings of corms and cormels are applied to stop bleeding of wounds and are used as anti-tetanus and anti-poison agents against tarantula, scorpion and snake bites.

Global awareness of health and environmental issues is spreading fast in recent years, especially in the developed countries. Organic farming is an alternative viable strategy targeting on sustainable production as well as soil, environmental and human health by excluding the use of synthetic chemicals and with maximum use of on- farm generated inputs. Aroids, viz., elephant foot yam, taro and tannia, do respond well to organic manures and there is great scope for organic production in these crops as well as for export. An attempt has been made in this paper to explore the potential of tannia for organic production.

Materials and Methods

Two separate field experiments were conducted in series at Central Tuber crops Research Institute (CTCRI), Sreekariyam, Thiruvananthapuram during April – January in 2003-2005 to evaluate the growth and yield response of tannia to organic management.

Experiment I: Eight organic and inorganic sources of nutrients were tested on the growth and yield of tannia in a field experiment laid out during 2003-04 in RBD with three replications. The treatments were the following :

T_{1-} N alone @ 80 kg ha^{-1}

T_{2-} P alone @ 50 kg ha^{-1}

T_{3-} K alone @ 100 kg ha^{-1}

T_{4-} FYM @ 12.5 t ha^{-1} and NPK @ 80:50:100 kg ha^{-1}

T_{5-} FYM @ 12.5 t ha^{-1} + ash @ 3 t ha^{-1}

T_{6-} Neem cake @ 1 t ha^{-1} + NPK@ 80:50:100 kg ha^{-1}

T_{7-} Neem cake alone @ 1 t ha^{-1}

T_{8-} FYM @ 12.5 t ha^{-1} and NPK @ 80:50:100 kg ha^{-1} + seed treatment with fungicide (SF) Bavistin @ 0.02%

T_{9-} absolute control

The soil of the experimental site is classed as an acid ultisol (pH 4.4). The soil was rated as low for available N (146.76 kg ha^{-1}) and available K (108.27 kg ha^{-1}) and high for available P (58.76 kg ha^{-1}). The test site experienced a typical humid tropical climate with mean annual rainfall of 1650.85 mm. The gross plot size was 4.5 m x 4.5 m accommodating 25 plants. A local variety of tannia was planted during April, grown rain-fed and harvested after 9-10 months. Field culture as per the package of practices recommendations was followed (KAU, 2002).

Plant and soil measurements

Observations on plant height and total number of leaves were recorded at 6 months after planting from 5 plants and the average value was computed. From each plot three plants were uprooted at harvest. Plants were separated into shoots, cormels and corms, air dried and then oven dried at 70°C to constant weight and dry weight of each plant part was recorded and expressed in grams. Based on these values, dry matter production of shoots, cormels, corms and whole plant was computed on g plant^{-1} basis. Harvest index was calculated by dividing the cormel dry weight by the total plant dry weight. At harvest, the number of cormels per plant, the mean cormel weight (g), fresh cormel yield and mother corm yield in t ha^{-1} were computed based on the data taken from the net plants. Available N, P and K status of the soil were estimated by standard procedures.

Experiment II: In the subsequent field experiment conducted during 2004-2005, the impact of 4 production systems viz., conventional, traditional, organic farming and using biofertilizers, replicated 5 times, was evaluated in RBD. In "conventional plots" the nutrient management practices as per the package of practices recommendations (FYM @ 12.5 t ha^{-1} and chemical fertilizers to supply NPK @ 80:50:100 kg ha^{-1}) was advocated. Farmer's practice of using FYM @ 25 t ha^{-1} and ash @ 2 t ha^{-1} was followed in "traditional plots". In "organic farming plots", FYM @ 20 t ha^{-1}, green manure (to incorporate 15-20 t ha^{-1} of green matter), ash @ 2 t ha^{-1} and neem cake @ 1 t ha^{-1} were applied to substitute chemical fertilizers. Seed rate of green manure cowpea was 20-25 kg ha^{-1}. Proper care was taken to avoid the use of any chemical input in organic plots. FYM@ 12.5 t ha^{-1}, mycorrhiza @ 5 kg ha^{-1}, *Azospirillum* @ 3 kg ha^{-1} and phosphobacterium @ 2.5 kg ha^{-1} were the sources of nutrients applied in plots assigned for evaluating the effect of biofertilizers. Organically produced planting materials of a local variety of tannia with good market preference and excellent cooking quality procured from Peermade Development Society, Pothupara, Idukki district, Kerala, was used for the study.

Plant measurements

Plant height and total number of leaves were recorded at 6 months after planting from 5 plants and the mean value was taken. At harvest the number of cormels per plant, the mean cormel weight (g), fresh cormel yield and mother corm yield in t ha^{-1} were computed based on the data taken from the plants in the net plot.

Statistical analysis

The analysis of variance was done using **MSTATC** programme following the method described by Cochran and Cox (1965).

Results and Discussion

Experiment I

Application of FYM @12.5 t ha^{-1} along with wood ash @ 3 t ha^{-1} (T_5) favoured canopy growth ie., plant height and leaf production. Crop growth was also favoured by the combined application of FYM @12.5 t ha^{-1} and NPK@ 80:50:100 kg ha^{-1} (Table 1). It is known that tannia responds well to organic manures and chemical

fertilizers (Karikari, 1971; Giacometti and Leon, 1994) and mere native soil fertility is not sufficient for its growth and productivity (Susan John and Suja, 2006).

Pattern of dry matter distribution in tannia (Fig. 1) revealed that 8-10% of total plant dry matter was allocated to shoots, 40-48% to cormels and 46-51% to mother corm. Among the treatments, FYM + ash resulted in significantly greater dry biomass accumulation in cormels and mother corm leading to higher total plant biomass. Higher shoot dry biomass was observed in NPK+ FYM and FYM+ ash treated plants. Harvest index did not vary considerably among treatments, though FYM + ash treatment favoured effective partitioning of assimilates for storage in cormels resulting in higher HI (0.47) and ultimately higher cormel yield (Table 1).

Application of FYM + ash, also favoured the yield attributes and resulted in significantly higher number of cormels (9.23), cormel yield (9.49 t ha^{-1}) and mother corm yield (11.69 t ha^{-1}) (Table 1). The nutritional requirement of tannia has not been standardized so far. However, in traditional tannia cultivation in Africa, Central America and parts of Pacific Islands, little or no fertilizers are used, particularly when the crop is grown on land that has been cleared from bush fallow (Onwueme and Charles, 1994). This indicates that tannia prefers soil rich in nutrients and organic management. Moreover, tannia is susceptible to soil acidity (Salas et al., 1996; Abruna Rodrigues et al., 1982) and the content of Ca in ash (20-40%) might have reduced soil acidity to some extent and favoured growth, biomass partitioning and yield attributes in tannia contributing to higher yield in FYM + ash treated plots in the present study. Susan John and Suja (2007) observed the interplay of 3 basic cations K, Ca and Mg as interfering with the growth of the crop. There was no significant difference in the chemical parameters of the soil due to the various treatments (Table 2).

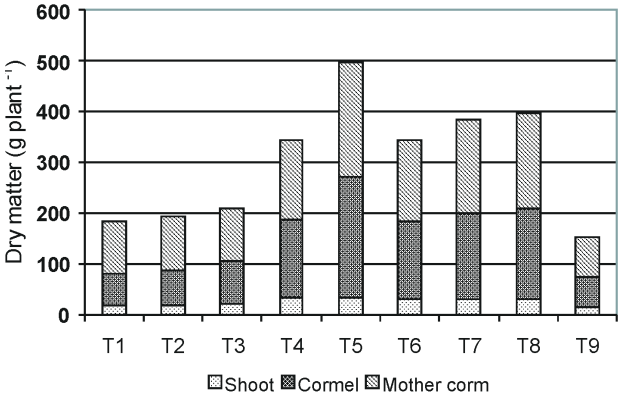

Fig 1. Effect of nutrient management practices on dry matter distribution in tannia

Experiment II

Among the various practices, organic farming proved superior, profoundly favoured plant height, leaf production and produced significantly higher cormel yield (11.252 t ha^{-1}) and mother corm yield (22.962 t ha^{-1}) (Table 3). Conventional practice resulted in significantly lowest yield. Traditional practice and biofertilizer applied plots, which were also strictly organic in nature, remained on a par. The results clearly indicated that tannia has great potential for organic production and prefers organic cultivation. In general, aroids do respond well to organic manures and there is ample scope for organic production in this group of crops (Suja and Nayar, 2006; Suja et al., 2006a; Suja et al., 2006b). Similar results have been reported in elephant foot yam, an important edible aroid (Suja and Sundaresan, 2008a ; Suja and Sundaresan, 2008b; Suja et al., 2008).

It is to be mentioned that having fewer pests and diseases compared to cereals and vegetables, the most important aspect in the organic production of tuberous vegetables like aroids, is the proper scientific use of a wide variety of easily available and cheaper organic sources of plant nutrients. Proper care was taken in the present study to substitute chemical fertilizers with organic manures like FYM, green manure, neem cake and ash to meet the NPK requirement of the crop. Thus the favourable soil physico-chemical-biological condition under the influence of these organic manures might have contributed to higher tannia production.

The organic farming technology package comprising of farmyard manure @ 20 t ha^{-1}, green manuring with cowpea to generate 15-20 t ha^{-1} of green matter in 45-60 days, neem cake @ 1 t ha^{-1} and ash @ 2 t ha^{-1} developed from this study requires further confirmation.

References

Abruna Rodriguez, F., Vincente- Chandler, J., Rivera, E. and Rodriguez, J. 1982. Effect of soil acidity factors on yields and foliar composition of tropical root crops. *Soil Sci. Soc. Amer. J.*, 46:1004-1007.

Agueguia A. 2000. Importance and uses of cocoyam in Cameroonian diets. In : *Potential of Root crops for Food and Industrial Resources*. Makoto Nakatani and Katsumi Komaki. (ed), Twelfth Symp. Int. Soc Trop. Root Crops ISTRC, September 10-16, 2000, Tsukuba, Japan, p. 512-514.

Table 1. Effect of nutrient management practices on growth and yield of tannia

Treatments	Plant height (cm)	Leaf production (no.)	No. of cormels	Mean cormel weight(g)	Cormel yield (t ha^{-1})	Mother corm yield (t ha^{-1})	Harvest index
T_{1}- N alone	89.11	5.33	4.55	54.21	2.93	5.26	0.35
T_{2}- P alone	85.89	5.89	5.08	50.74	3.16	5.53	0.35
T_{3}- K alone	89.78	5.33	5.61	53.47	3.68	5.19	0.40
T_{4}- NPK+ FYM	111.11	6.11	6.46	99.36	7.86	8.93	0.39
T_{5}- FYM+ ash	132.78	6.44	9.23	94.43	9.49	11.69	0.47
T_{6}- Neem cake + NPK	106.33	5.77	6.03	94.41	6.57	8.51	0.44
T_{7}- Neem cake alone	90.67	5.55	7.02	77.63	6.72	9.15	0.44
T_{8}- NPK+FYM+SF	108.00	6.22	7.06	97.29	7.95	9.48	0.40
T_{9}- Control	87.22	5.54	2.77	81.10	2.75	3.78	0.38
CD (0.05)	8.881	NS	3.235	NS	1.409	1.358	NS

Table 2. Effect of nutrient management practices on chemical parameters of soil under tannia

Treatments	pH	Available N kg ha^{-1} (kg ha^{-1})	Available P_2O_5 (kg ha^{-1})	Available K_2O (kg ha^{-1})
T_{1}- N alone	4.68	168.51	54.29	113.21
T_{2}- P alone	4.82	165.79	75.04	105.28
T_{3}- K alone	4.72	144.04	43.99	103.04
T_{4}- NPK+ FYM	4.65	184.81	53.31	322.00
T_{5}- FYM+ ash	4.75	146.76	53.45	119.84
T_{6}- Neem cake + NPK	4.57	154.92	64.27	128.80
T_{7}- Neem cake alone	4.77	195.68	38.27	151.20
T_{8}- NPK+FYM+SF	4.67	157.63	42.51	204.40
T_{9}- Control	4.88	146.76	88.44	129.92
CD (0.05)	NS	NS	NS	NS

Table 3. Comparison of growth and yield of tannia under organic and conventional management

Production systems	Plant height at 6 MAP (cm)	Leaf production at 6 MAP (number plant $^{-1}$)	Cormel yield (t ha^{-1})	No. of cormels plant $^{-1}$	Mean cormel weight (g)	Mother corm yield (t ha^{-1})
Conventional	102.80	7.53	3.88	4.81	68.61	9.19
Traditional	111.07	7.47	5.76	4.62	103.01	11.06
Organic	131.13	8.99	11.25	8.08	115.87	22.96
Biofertilizers	111.47	7.87	5.93	4.50	121.35	10.17
CD (0.05)	12.32	0.97	2.20	2.22	27.22	4.68

Cobley, L.S. and Steele, W.M. 1976. *An Introduction to the Botany of Tropical Crops*. 2nd Edition, Longman, London, New York. p. 311.

Cochran, W. G. and Cox, G. M. 1965. *Experimental Designs*. Asia Pub House, Bombay.

Giacometti, D.C. and Leon, J. 1994. Tannia. Yautia (*Xanthosoma sagittifolium*). In: *Neglected Crops: 1492 from a different perspective*. Plant Production and Protection Series No. 26. FAO, Hernando Bermejo, J. E. and Leon, J. (eds.), Rome, Italy, pp. 253-258.

KAU. 2002. *Package of Practices Recommendations:Crops,* Directorate of Extension, Kerala Agricultural University, Mannuthy,Thrissur: pp.49-53.

Karikari, S. K. 1971. *Cocoyam Cultivation in Ghana*. Legon Extension Bulletin No.13, University of Ghana, Agricultural Research Station, Kade, p.12.

Lauzon, R.D., Shiraishi, K., Yamazaki, M., Sawayama, S., Sugiyama, N. and Kawabata, A. 1995. Physicochemical properties of cocoyam starch. *Food Hydrocolloids*, **9** (2): 77-81.

Liefstingh, A. 1963. Vegetables. Memorandum No..3, University of Ghana, Agricultural Research Station, Kade, pp.48-50.

Onwueme, I.C.1978. *Colocasia* and *Xanthosoma* (Cocoyam). In: *The Tropical Tuber Crops: Yams, Cassava, Sweet potato and Cocoyam*. John Wiley & Sons Ltd., New York, pp. 589-606.

Onwueme,I.C. and Charles,W.B. 1994. *Tropical Root and Tuber Crops –Production, Perspectives and Future Prospects,* FAO production and protection paper. 126. Rome. pp.139-161.

Salas, R., Molina, E. and Bouldin, D. 1996. Lime response to tanier in ultisol of Costa Rica. *Commun. Soil Sci. Pl. Anal.,* **27** (9-10): 2477-2484.

Shiraishi, K., Lauzon, R.D., Yamazaki, M., Sawayama, S., Sugiyama, N. and Kawabata, A. 1995. *Food Hydrocolloids*, **9**(2):67-75.

Suja, G. and Nayar, T. V. R. 2006. Organic tuber production: Issues, prospects and future strategies. *Kisan World*, **33**(11): 58-59.

Suja, G., Nayar, T. V. R., Potty, V.P. and Sundaresan, S. 2006a. Organic farming: An alternative option for tuber crop production. *CTCRI News*, **23**(1): 4-5.

Suja,G., Nayar, T.V.R., Potty,V.P. and Sundaresan, S. 2006b. Organic farming: a viable strategy for high yield and quality tuber crop production. *Ind. Hort.,* **51**(6): 4-5.

Suja, G. and Sundaresan, S. 2008a. Agronomic, nutritional and economic implications of organic elephant foot yam production. In: *Programme and Abstracts of the National Conference on Organic Farming in Horticultural Crops with special reference to Plantation Crops*, 15-18 October 2008, Central Plantation Crops Research Institute, Kasaragod. p.33-34.

Suja, G. and Sundaresan, S. 2008b. Organic elephant foot yam production: A feasible strategy for high yield and income. In: *Abstract Book. Status Papers and Extended Summary*, National Seminar on Amorphophallus: Innovative Technologies, 19-20 July, 2008, Patna, Bihar, p.139-141.

Suja, G., Potty, V. P. and Sundaresan, S. 2008. Organic farming of aroids and yams: A feasible alternative farming strategy. In: *Proceedings of the 20 th Kerala Science Congress 2008*. 28-31 January 2008, Thiruvananthapuram, p.87-89.

Susan John, K. and Suja, G. 2006. Determination of optimum nutrient rate and nutritional constraints in tuber crops growing acid ultisol. In: *Abstracts of Papers 14 th Triennial Symposium of the International Society for Tropical Root Crops,* 20-26 November 2006, Thiruvananthapuram, Kerala, India. pp.189-190.

Susan John, K. and Suja, G. 2007. Nutritional factors limiting the growth and yield of tannia in an acid ultisol. *Proceedings National Symposium on Soil Science Research: Retrospect and Prospect in the context of Environmental Quality and Food Security* , Kolkata, December 7-9 2007, p.102-103.